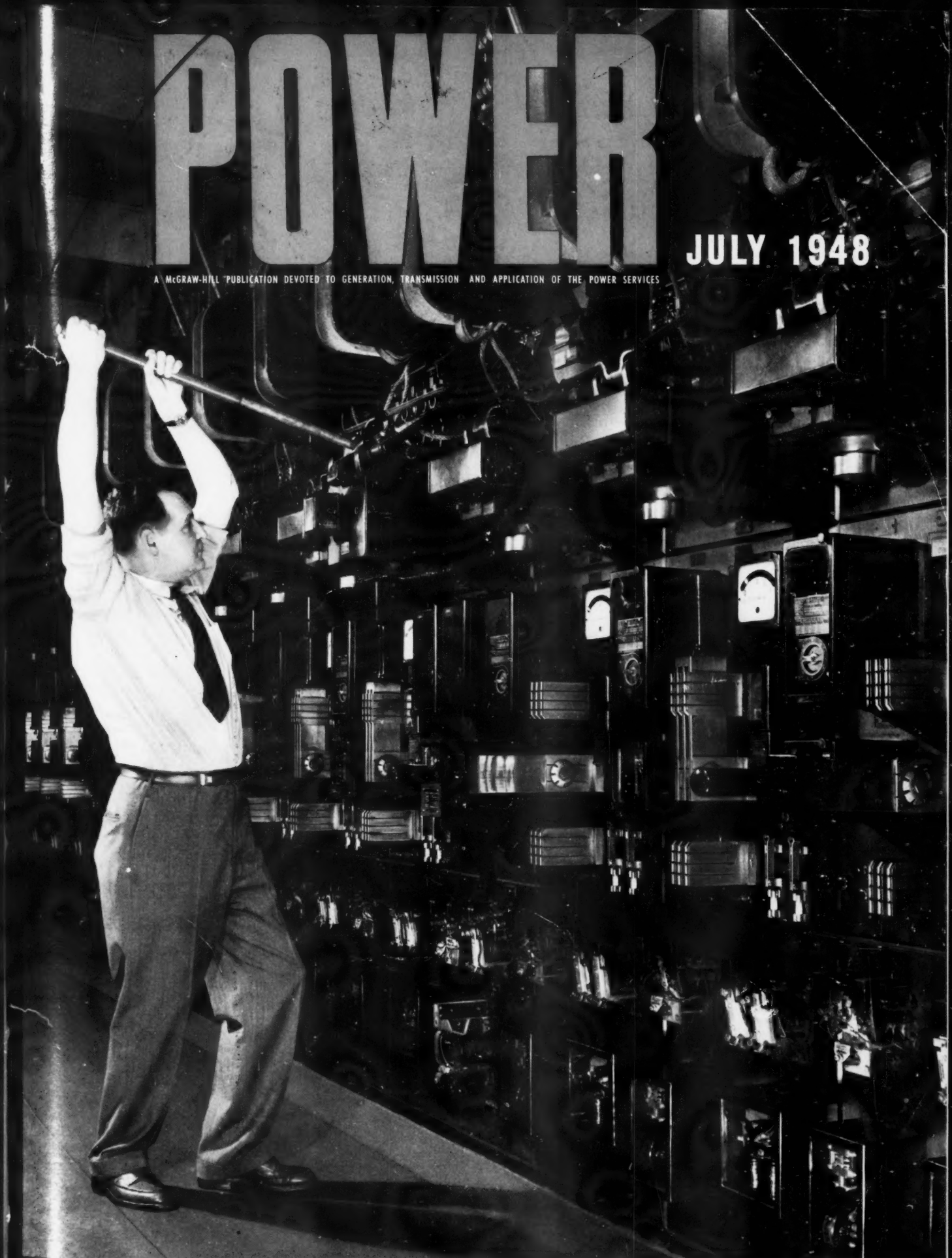
POWER

JULY 1948

A McGRAW-HILL PUBLICATION DEVOTED TO GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES



Special section in this issue: **CIRCUIT PROTECTION**

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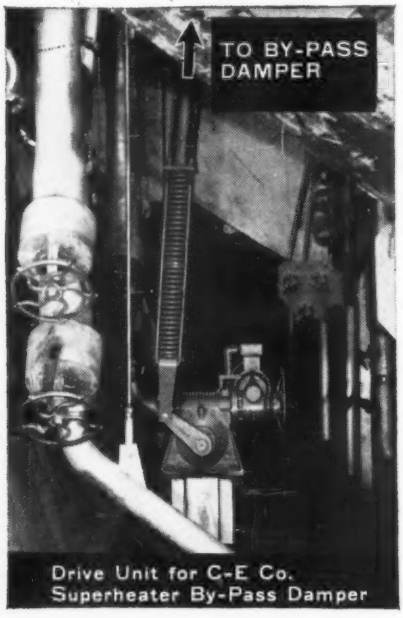
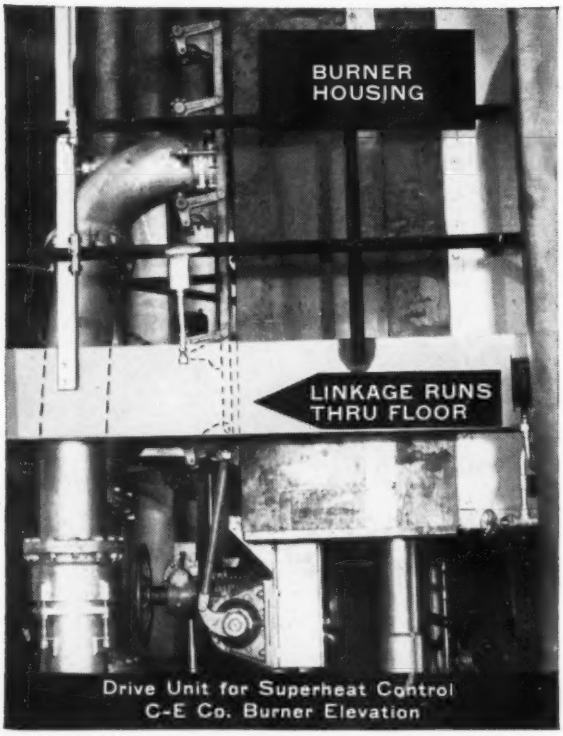
Superheat Control? Investigate MICROMAX With Its Fast, Positive, Electric Drive Units

MICROMAX SUPERHEAT CONTROLLER
MICROMAX STEAM-TEMP. RECORDER
Section of Boiler Control Board, Havana Station, Illinois Power Co.





THE precise, dependable action of Micromax Superheat Control is well illustrated in its application to Combustion Engineering Co.'s regulating mechanism.

C-E's method of varying the number of Btu's to the superheater involves both tilting the four fuel burners up or down, and moving the superheater's by-pass damper.

Micromax Control System regulates burners and damper through five powerful, electric Drive Units. Four Units move the burners. They operate in unison, to the same tilt angle, because all respond to a single Micromax Controller. The fifth Drive Unit operates the by-pass damper, in automatic coordination with the burner-tilts.

Micromax System readily accommodates itself to details of installation which vary with the boiler. Always, the Superheat Control is sensitive, accurate and dependable.

Other advantages of the Micromax system apply to any type of superheat control:

1) Heaviest dampers, louvres, vanes, etc., move quickly to exact position, because the Units' reduction gears apply high torque with high precision.

2) Dampers, etc., stay in position even in event of power failure, because back-drive through the gear train is impossible.

3) Operator can then easily position dampers manually with a handwheel, if ever desired.

4) Continuity of service is high, because equipment uses dependable electric power.

5) Inherent lag between change in boiler load and change in steam temperature is minimized.

For further information, write Leeds & Northrup Co., 4910 Stenton Ave., Phila. 44, Pa.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · AUTOMATIC CONTROLS · TELEMETERS
HEAT-TREATING FURNACES

Jrl Ad N-01-463(1)

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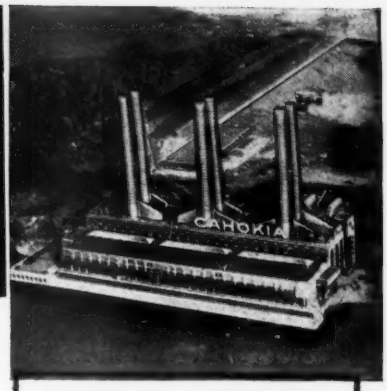
LINK-BELT Equipment
Unloads, Stores, Reclaims Coal at Cahokia Station



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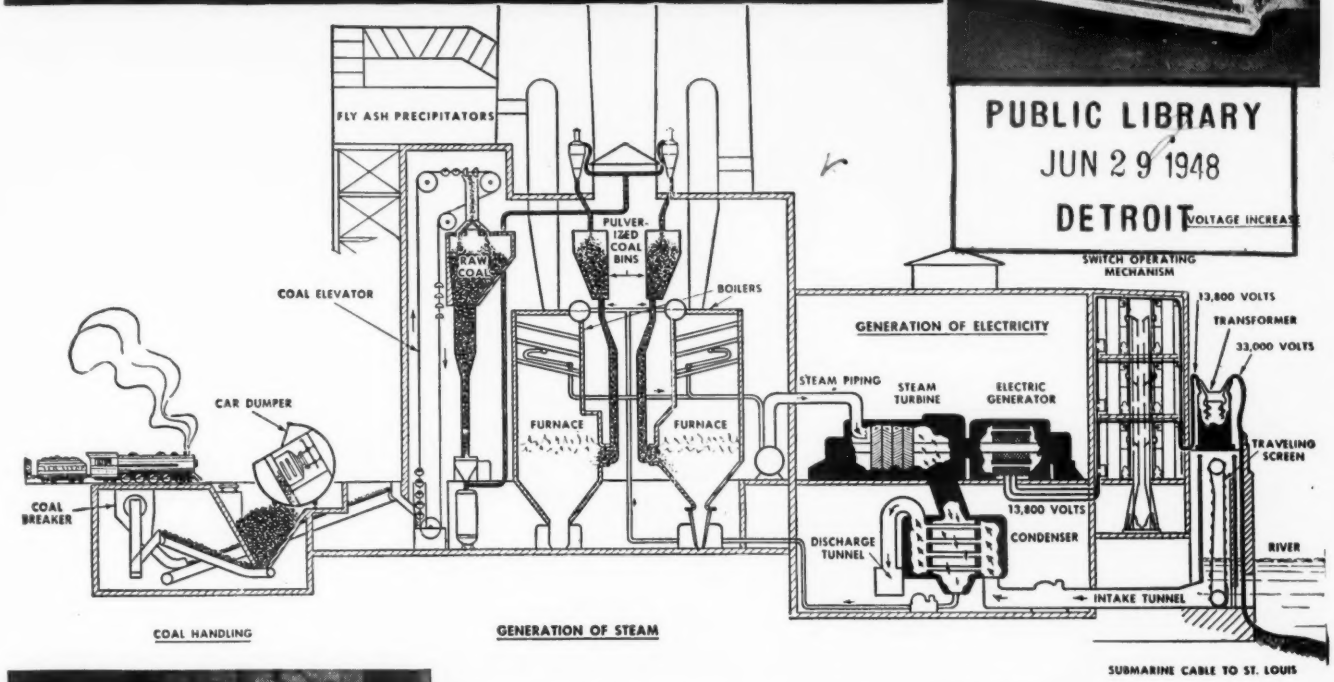
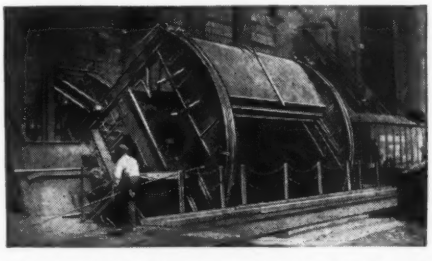




Above: Link-Belt Rotary R. R. Car Dumper in action. It was installed in 1923, when first section of the Cahokia Station was built.
Below: Shows coal being discharged from stocking-out conveyor and how tractor-mounted scrapers or bulldozers are used for moving initial storage pile, spreading the coal, and compacting it throughout storage yard.

Pulverized coal plant of Union Electric . . . first section built in 1923

Cahokia is distinguished by being the largest in the Mississippi Valley (300,000 kw) . . . by being one of the first central stations to operate on pulverized coal . . . and for having served the St. Louis area for a quarter of a century.

Achieving efficiency and economy in coal handling for a plant of this size was a major problem, and it was solved in a highly satisfactory way by an integration of Link-Belt standard units.

From the Link-Belt Rotary Car Dumper, the coal goes to a receiving hopper, from which conveyors carry it into the plant or out to the yard for storage. The Link-Belt equipment includes an inclined apron conveyor . . . conveyors to coal breakers . . . belt conveyors from breakers to bucket elevators . . . distributing belt conveyors with trippers . . . and an underground conveyor system for reclaiming coal from yard hopper.

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

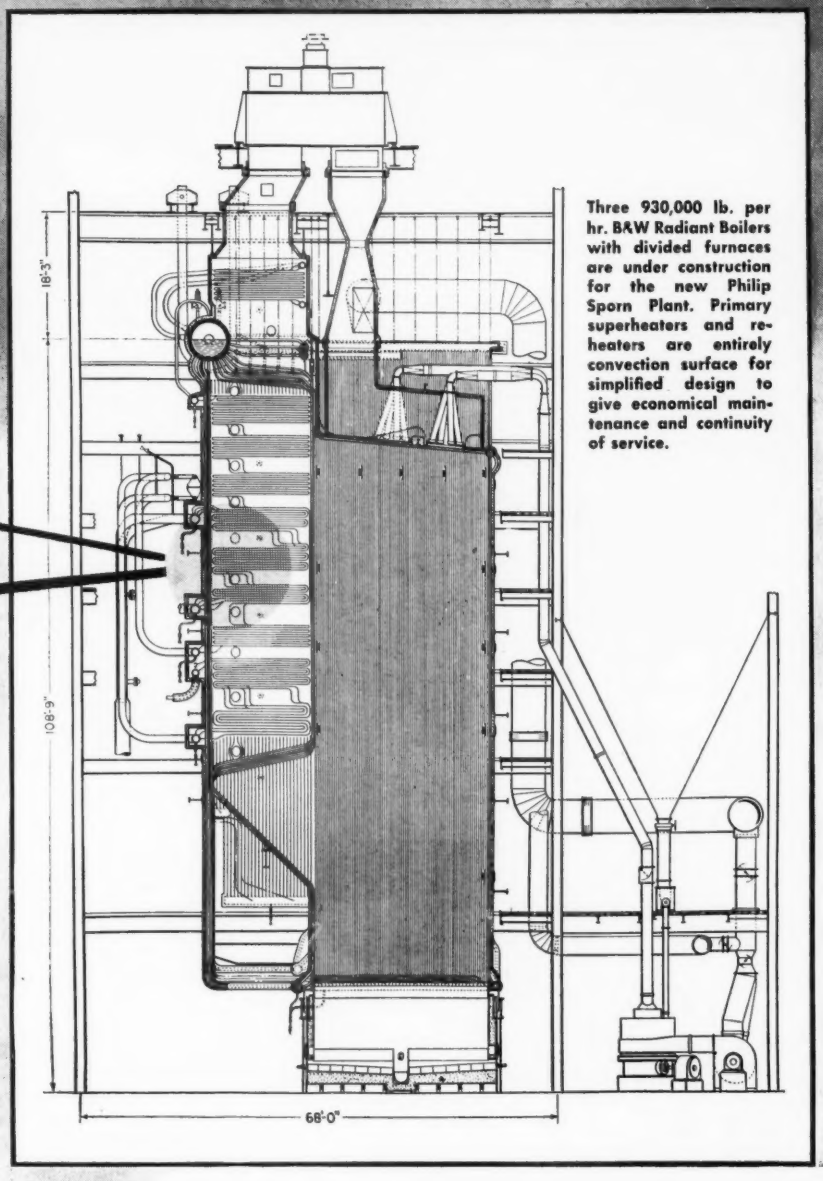
10,972

LINK-BELT
THE SYMBOL OF QUALITY — LB — LINK-BELT
COAL AND ASHES HANDLING EQUIPMENT

REHEAT

Architects' sketch of new Philip Sporn Plant, design and construction of which is under supervision of the American Gas and Electric Service Corporation.

FOR POWER PLANTS—B&W, Open-Pass, Radiant, Integral-Furnace, Cross-Drum, Stirling and Waste-Heat Stationary Boilers Cooled Furnaces . . . Oil, Gas & Multifuel Burners . . . Chain-Grate Stokers . . . Stacks and Breechings . . . Seamless & Refractories . . . Chemical Recovery Units . . . Alloy Castings. OTHER B&W PRODUCTS — Marine Boilers . . .



Three 930,000 lb. per hr. B&W Radiant Boilers with divided furnaces are under construction for the new Philip Sporn Plant. Primary superheaters and reheaters are entirely convection surface for simplified design to give economical maintenance and continuity of service.

FOR TODAY'S HIGH FUEL COST

Today's rising fuel costs, and other unfavorable operating conditions are placing increased emphasis on the economic advantages of *reheating* steam in high-temperature central-station boilers. How importantly a reheat cycle can help maintain power prices at low levels is indicated by results being designed into the new Philip Sporn Plant of the American Gas & Electric System. It will have the *lowest heat rate ever attained* in any steam-electric generating station—9270 Btu per kwhr. output, with a boiler efficiency of 90 per cent.

Three B&W Radiant Boilers for this station will generate 930,000 lb. of steam per hr. each at 2080 psi and 1050F. A reheater on each unit is proportioned to raise the temperature of 840,000 lb. of steam per hr. from 650F to 1000F at 390 psi. High pressure and reheating will make possible the production of *a kwhr. with several per cent less coal* than a straight regenerative cycle.

Helping central stations to get the lowest power cost with whatever fuels are available at any time is an old story with B&W. It will pay you, too, to call on this long B&W experience on any plans involving high-temperature steam generation.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
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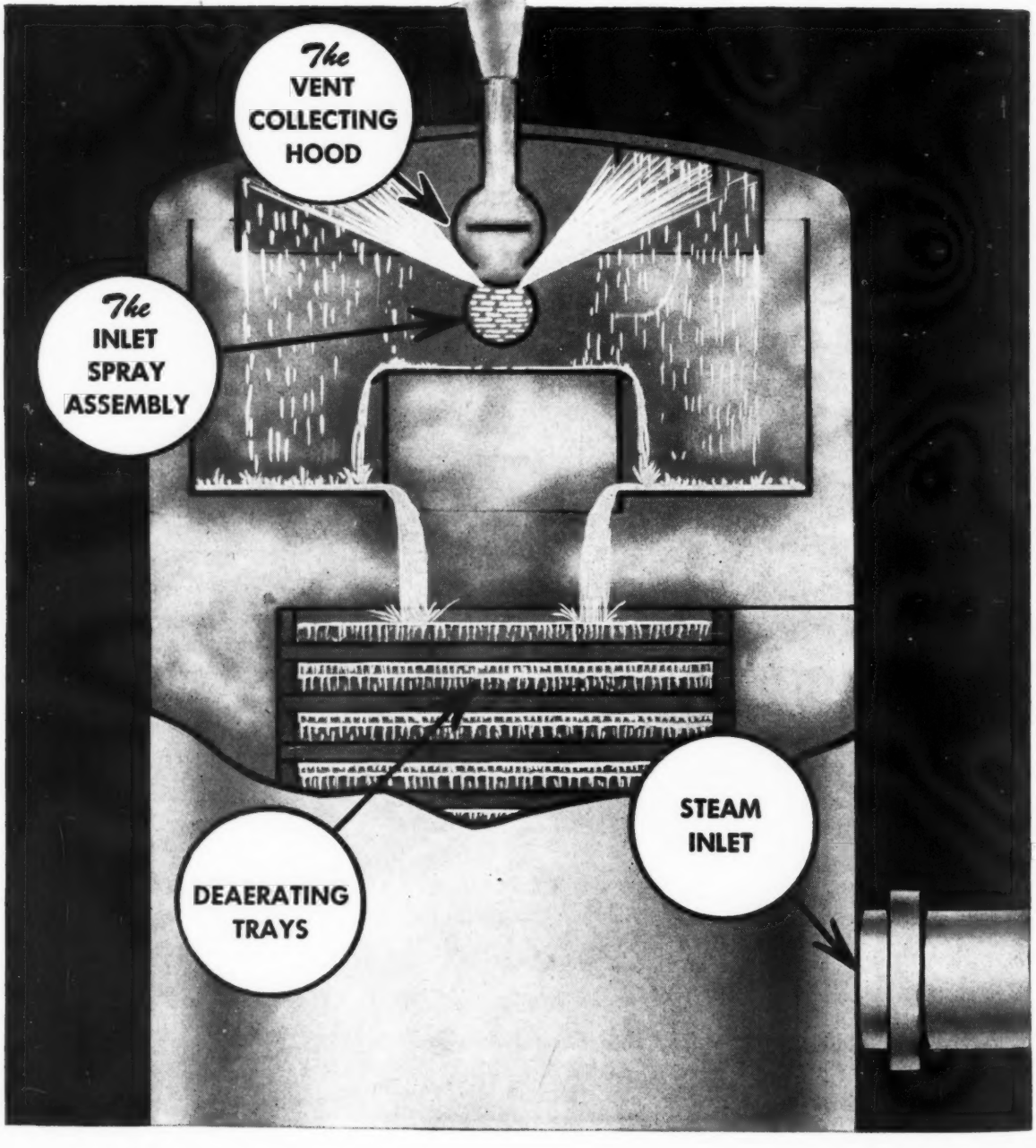
WORKS: ALLIANCE AND BARBERTON, O.; AUGUSTA, GA.

G-393 T

. . . Air Heaters . . . Economizers . . . Superheaters . . . Water-Welded Tubes for All Pressure and Mechanical Applications . . . Pressure Vessels . . . Process Equipment.

THE *new* Elliott

EXIT CORROSIVE



ELLIOTT COMPANY PLANTS AT: JEANNETTE, PA. RIDGV

SPRAY-TRAY DEAERATING HEATER

GASES

with no tubular vent condenser, no corrosion of parts, no maintenance.

The operation of the new Elliott deaerating heater is simple. The incoming water, agitated and broken into sheets and droplets, falls through the steam flow rising to the top of the unit. Most of the heating occurs in the upper section, so that as the water reaches and passes through the deaerating trays it readily gives up its oxygen and other noncondensable gases, which are swept upward by the steam to the vent collecting hood. At this point the steam is condensed by the incoming water, while the noncondensable gases are forced out the vent.

The big advance in the new design is the elimination of the tubular vent condenser, which has been a main cause of maintenance. Headroom is lowered too, and some piping is eliminated. Furthermore, stainless steel is used in the vent collecting hood, baffles and trays. No undeaerated water contacts the steel shell.

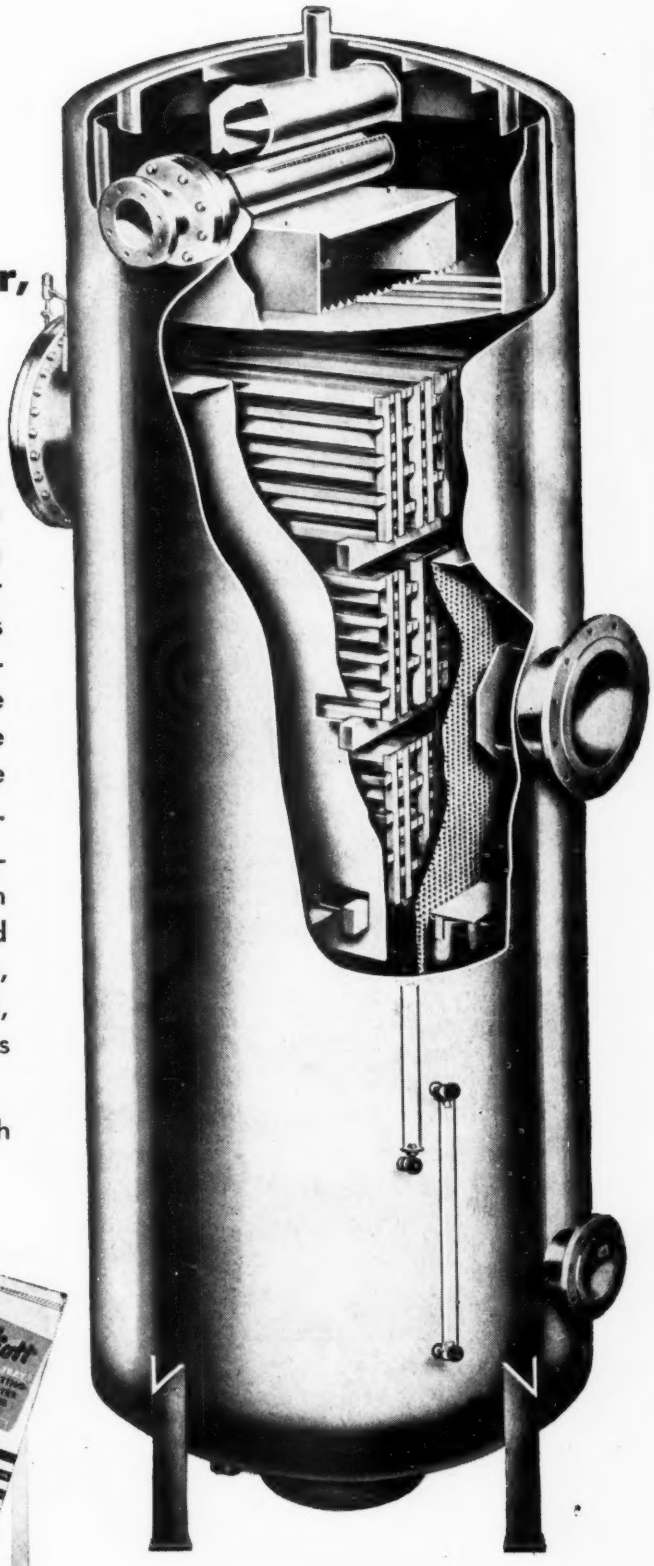
With this unit Elliott engineering hits a new high in deaeration operating economies.

Besides the protection of deaeration, deaerating heaters are a good investment from the standpoint of efficient feedwater heating. They heat the water up to the temperature of the saturated steam supplied to the heater.

For Complete Details, Write for Bulletin PN-16

Address:

TECHNICAL DATA DEPT.
ELLIOTT COMPANY, JEANNETTE, PA.



N-993

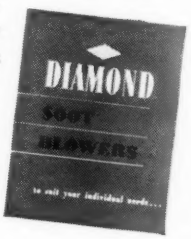
DIAMOND AUTOMATIC OPERATION eliminates the "HUMAN VARIABLE" from the soot blower equation

The human variable in the soot blower equation can often cost money and cause trouble. If some of the blowers are missed or incorrectly operated, the boiler efficiency can be seriously impaired and damage may result.

Diamond Automatic Operation eliminates the human variable from boiler cleaning. None of the blowers can be missed or incorrectly operated because pushing a button or pulling a control starts an automatic sequence which follows through a predetermined cycle to completion. Each blower is operated in turn . . . operated exactly right.

You do not have to try to train an operator to a rigid routine—do not have to provide constant supervision. You *know* your boilers will always be cleaned completely and correctly.

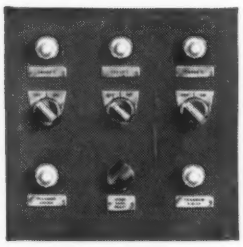
Diamond Automatic Operation is available with air or steam blowing, or both. One blowing sequence is set up to include all blowers . . . in boiler, superheater and economizer. It saves time, too . . . after the operator simply pushes the botton or pulls the control, he's free for other duties.



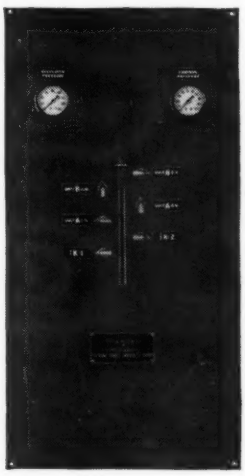
Write for Bulletin 1014

Beginning on Page 4 is a detailed description of Diamond Automatic Sequential Soot Blowing and its many advantages.

DIAMOND Electric Control Panel



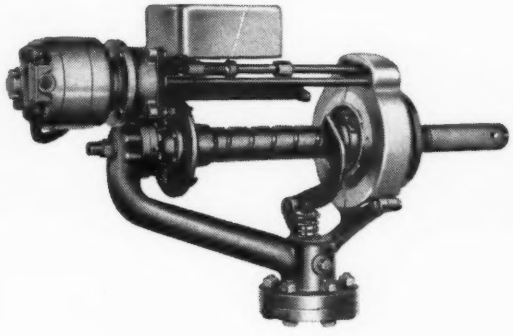
For automatic operation of any number of units individually or in groups. Operator simply presses one "start" button to begin the predetermined cleaning cycle. Light signals show units in operation and where cleaning has been completed.



DIAMOND Air Control Panel

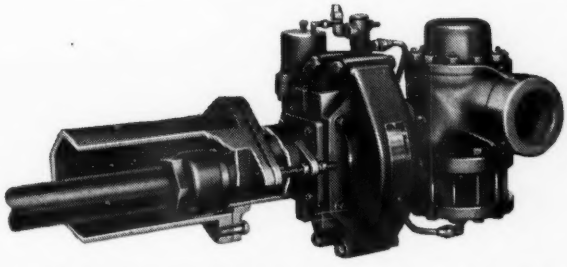
To start the automatic cleaning cycle of any arrangement of the various types of blowers, operator simply moves start and stop valve carrier to its down position, opening main control valve. Travelling upward it operates each selected unit or group in turn. When the last unit has completed its cycle, carrier moves to top of slot and closes valve. There are no electrical connections whatever on this panel.

DIAMOND Model IR
Short Retracting Soot Blower



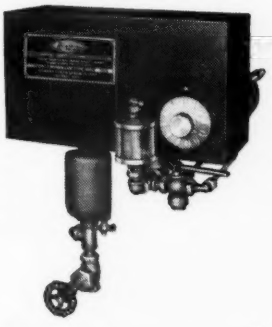
For cleaning either furnace walls or boiler heating surfaces where gas temperatures exceed limit for permanently installed units. Equally applicable to compressed air or steam as the cleaning medium. Manual, air, or electric operation. Advantages include: positive poppet type valve, 12" nozzle travel, no lubrication, simple construction, compact, exceptional durability, etc.

DIAMOND Model A2E
Automatic Air Puff Soot Blower

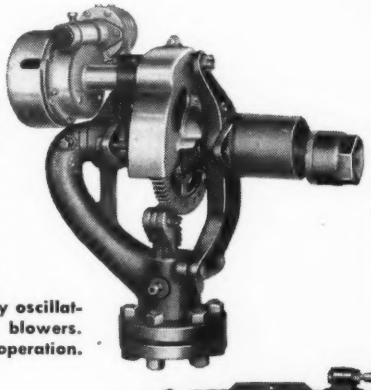


Automatically cleans heating surfaces by means of a series of compressed air puffs delivered through a standard multiple nozzle blowing element. During the puff—when air is blowing—the element is automatically rotated through a small arc; sufficient puffs are provided to complete blowing arc. Spreading cleaning over longer period permits use of a much smaller compressor and receiver—eliminates upset operating conditions—expels soot in small quantities.

The Air Puff Master Controller automatically controls the blowing operation of all the A2E units to which it is connected. The operator simply opens one valve . . . the controller does the rest: controls puff duration and interval, regulates element rotation, opens and closes air valve in head, determines sequence.



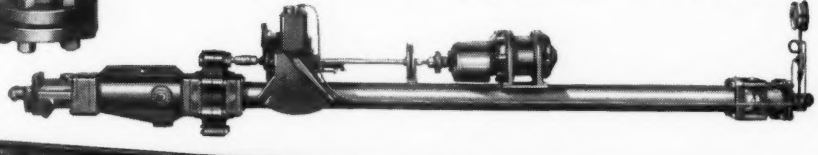
DIAMOND Model G9B
Steam Soot Blower

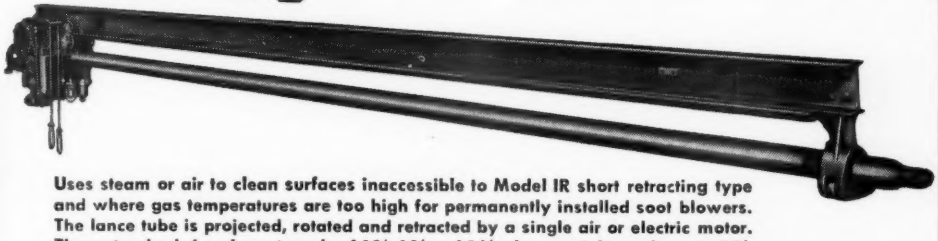


Employs steam as the cleaning medium through multiple nozzle, permanently installed element. Automatic valved—it goes through a complete operating cycle as the single chain is pulled. Cam and trigger operation of durable poppet valve saves up to 50% of steam used by oscillating valve in head blowers. Manual, air or electric operation.

DIAMOND Telescopic
Long Retracting Soot Blower

Used where insufficient clear space outside boiler will not permit installation of Model IK retracting blower for cleaning surfaces inaccessible to short retracting blower and where gas temperatures are too high for permanently installed units. Uses air or steam as cleaning medium. Either electric or air operation.



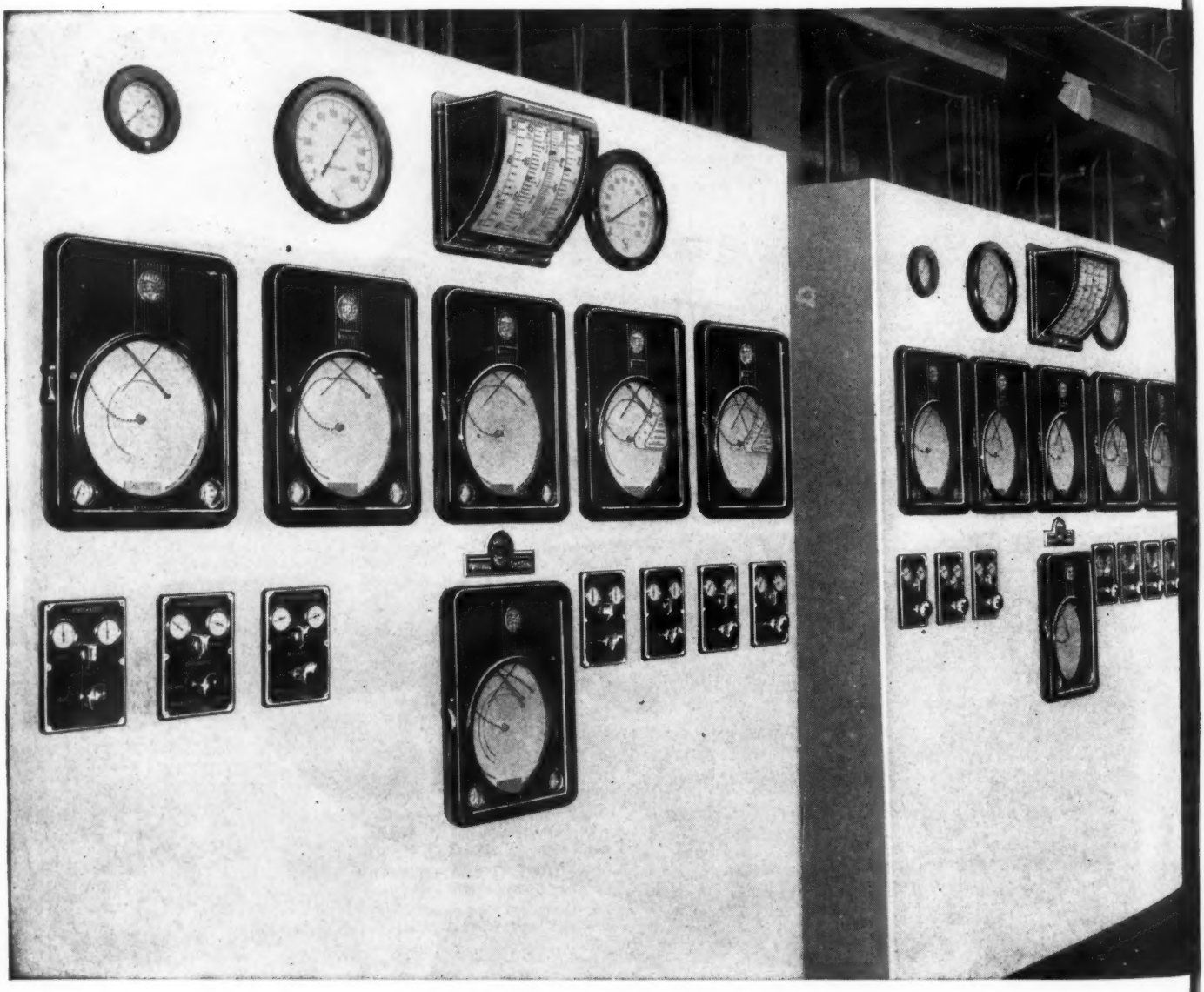


DIAMOND Model IK Long Retracting Soot Blower

Uses steam or air to clean surfaces inaccessible to Model IR short retracting type and where gas temperatures are too high for permanently installed soot blowers. The lance tube is projected, rotated and retracted by a single air or electric motor. Three standard sizes have travels of 10', 12' and 16'; also special travels up to 20'.

DIAMOND POWER SPECIALTY CORPORATION
DETROIT 31, MICHIGAN
DIAMOND SPECIALTY LIMITED — Windsor, Ontario

some Btu's are always



Btu's receive no vacations from this co-ordinated Bailey boiler control system on a 135,000 lb. per hr. capacity gas and oil-fired boiler. Controls for combustion, feed water, steam temperature and flue gas temperature are included on this panel.

Branches in: Boston, New York, Schenectady, Philadelphia, Buffalo, Pittsburgh, Charlotte, Cleveland, Detroit, Cincinnati, Atlanta,

on vacation

Yes, some Btu's are always on vacation. Your problem is to prevent too many from getting the habit. Loafing Btu's produce no power. You have to make them work. Then you get low power costs. And that is what you get when you install the Bailey co-ordinated boiler control system.

The Bailey system reduces fuel consumption per pound of steam generated. Combustion, feed water, steam temperature, heater levels, pump speeds and other factors are co-ordinated. Safety of operation is increased—continuity of service is improved. You convert the maximum number of Btu's into power and get all the efficiency your boiler was designed to deliver.

One thing to remember. The Bailey system is not delivered as a standard package. Each one is designed and engineered to the specific job on which it is to be used. That's why it functions so efficiently.

If you are looking for low cost power, it will pay you to call our nearest office.

A-106-2

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

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Controls for Steam Plants

COMBUSTION • FEED WATER • TEMPERATURE
PRESSURE • LIQUID LEVEL • FEED PUMPS

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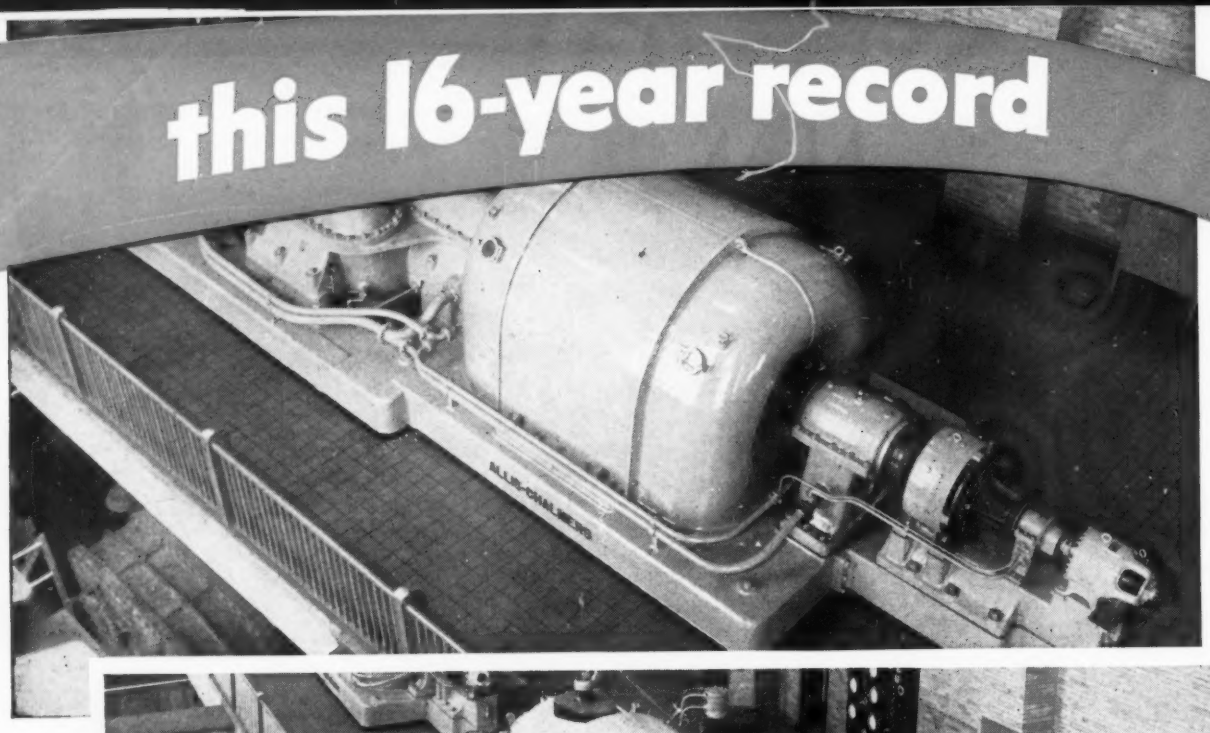
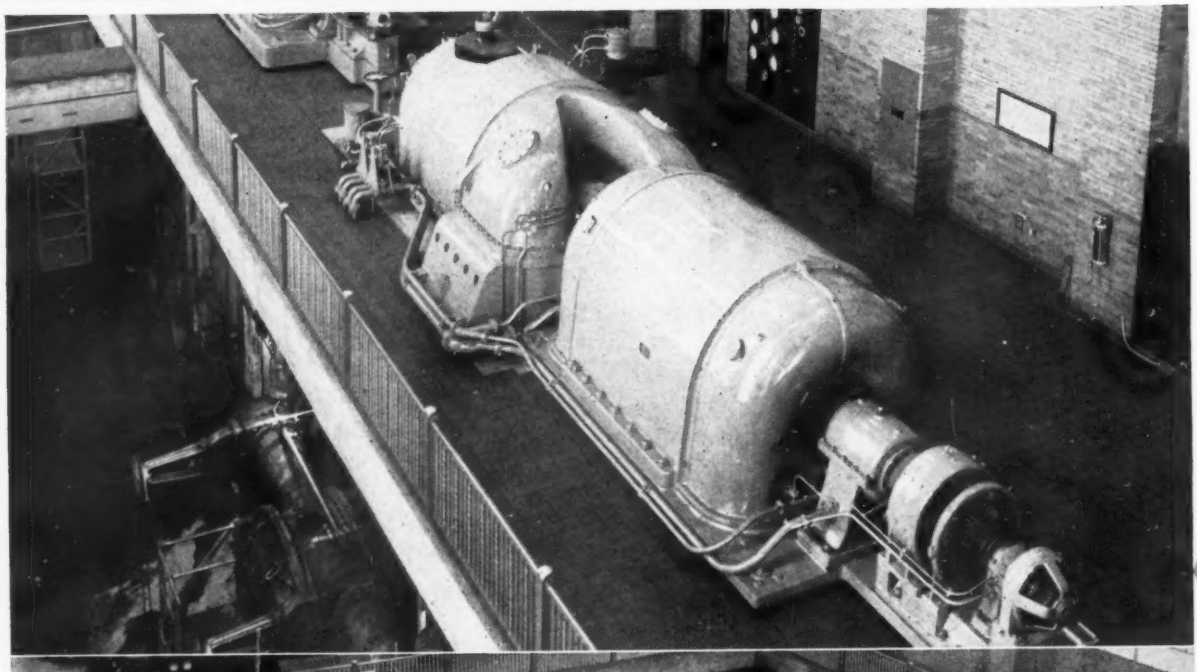
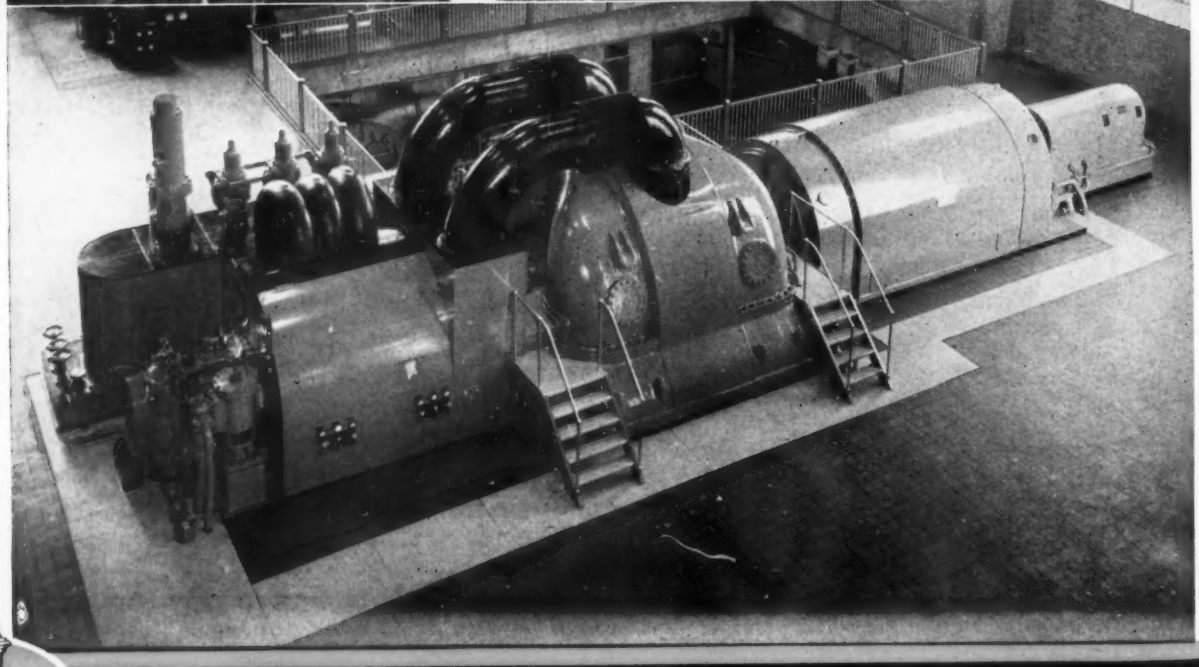
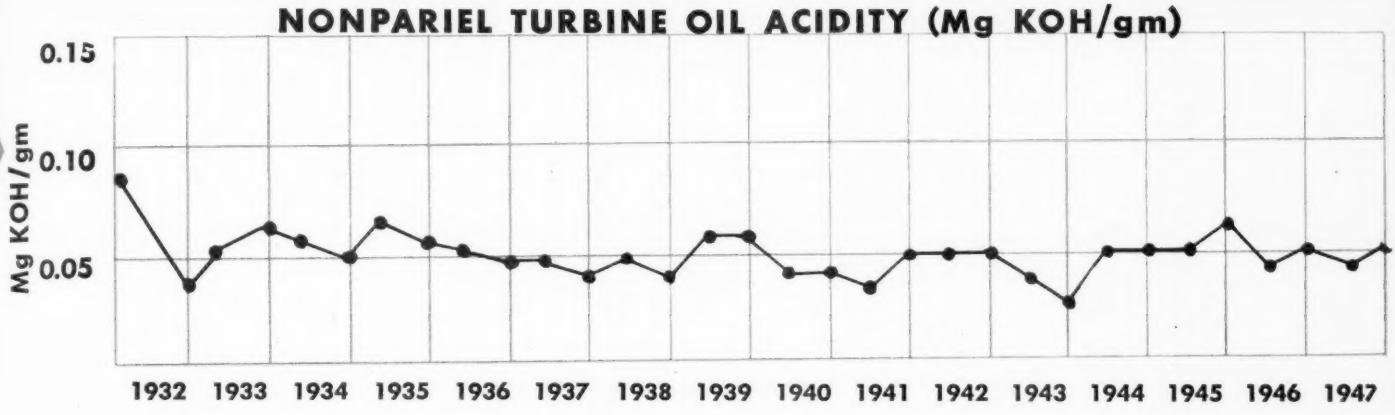
this 16-year record







STANDARD OIL COMPANY (INDIANA)



. . . of low acidity puts NONPAREIL TURBINE OIL into these two units

Acidity always very low . . . oil never taken out for treating . . . oil system never in need of cleaning . . . turbine never shut down for lubrication trouble of any kind! That's the 16-year record of Nonpareil Turbine Oil in a 7500 KW unit of a midwest power plant. And it's the record that was responsible for putting Nonpareil into units of 12,500 KW and 20,000 KW in the same plant.

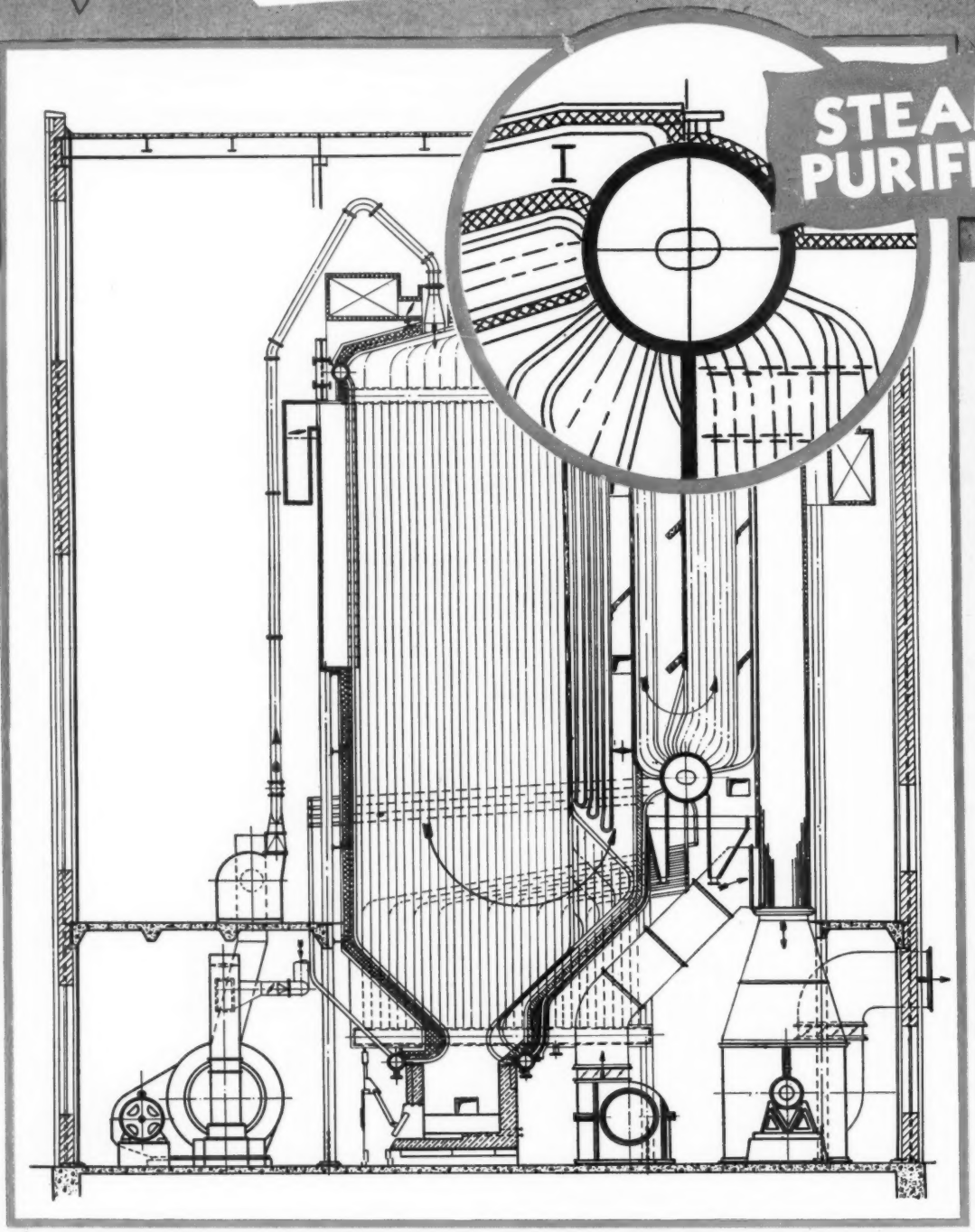
When you use Nonpareil, low acidity is so certain that we give you a written guarantee that the oil will not "increase in acidity above 0.15 mg KOH/gm." This guarantee is your insurance against outages caused by oil failures.

And, if you are installing a new turbine, Nonpareil will help you reduce your investment. It eliminates the need for extra batches of oil and auxiliary equipment for oil treating, such as tanks, pumps, and piping. A Standard Oil Lubrication Engineer can give you all the facts. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois for the engineer nearest you.

STANDARD OIL COMPANY (INDIANA) STANDARD

KVS Engineered

STEAM PURIFIER



KVS PRODUCTS

Boilers . . . Air Swept Tube Mill Pulverizers . . . Fans . . . Preheaters . . . Superheaters . . . Economizers . . . Water Walls . . . Coal Elevators . . . Bunkers . . . Ash Conveyors . . . Coal-Weighing Scales.

STEAM PURIFICATION

Impurity carryover is less than .5 parts per million

The KVS Cyclone Type Steam Dryer and Purifier produces steam in which the impurity carryover is less than .5 parts per million and the moisture content less than ¼ of 1% with 100% feed water make up.

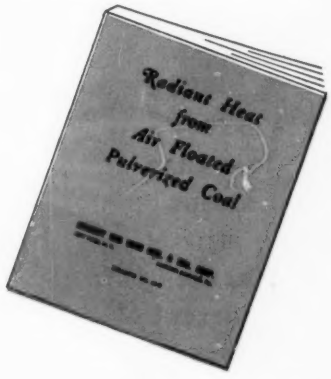
Recontamination of boiler water is eliminated in the KVS Cyclone System by collecting solids and removing them from the boiler. These solids are then passed through heat recovery equipment.

Installation of KVS steam purifying equipment is arranged to avoid interference with boiler tube servicing.

The KVS Cyclone Steam Purification System is designed to meet individaul requirements, insuring maximum operating efficiency at all boiler ratings.

We have not featured KVS Air Swept Tube Mills with automatic controls here, because we believe the industry recognizes their superiority.

These and all other components of KVS Steam Generating Units are engineered to meet specific operating conditions on available fuels in order to assure the maximum in operating efficiency and economy at all boiler ratings.



KVS ENGINEERING SERVICE

KVS Steam Generating Equipment has been performance proved over the years. KVS offers a complete srvice in design, building and erecting complete plants under one responsibility. KVS engineers are available for consultation on your requirements.
Ask for a copy of 97-page Engineering Bulletin No. 44-B containing valuable information on preparation of pulverized fuel and steam generating plants.

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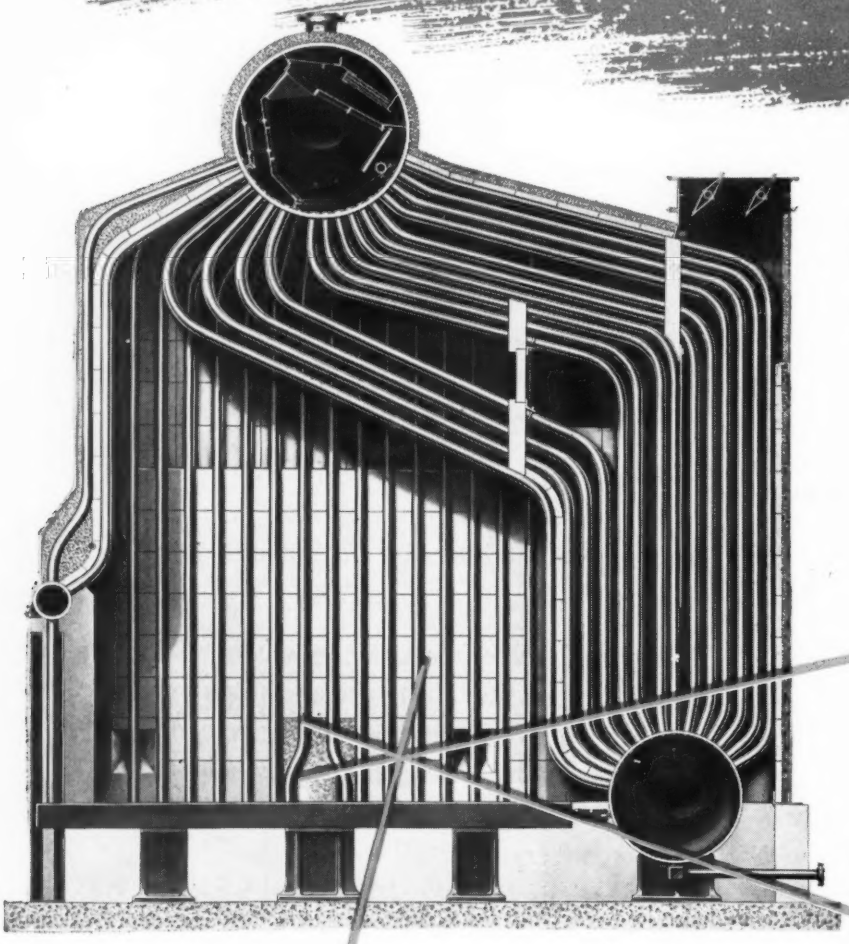
ARMY E NAVY

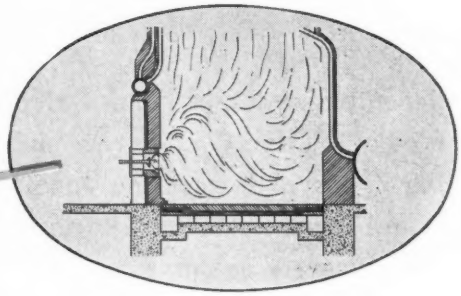
THE C-E PACKAGE BOILER



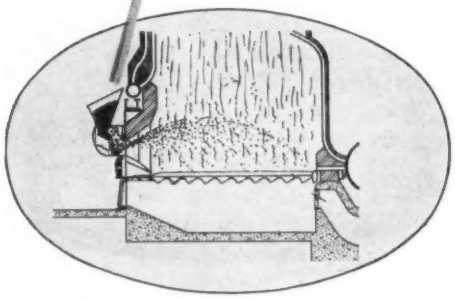
Furnished in capacities of

15,000 to 50,000

lb of steam per hr, the Package Boiler is designed for four methods of firing — spreader stoker, single-retort underfeed stoker, oil or gas burners. Any of these methods may be substituted for any other should a change in the fuel market make a change in firing equipment desirable.



OIL OR GAS BURNERS — The Package Boiler is ideally suited to the use of either oil or gas. Designed for front wall firing, the furnace is properly proportioned for the normal flame characteristics of the burners and provides ample volume for completion of combustion before the gases enter the boiler.



C-E SPREADER STOKER — Installations of C-E Spreader Stokers throughout the United States and in many foreign countries have demonstrated the ability of this stoker to burn every kind and grade of bituminous coal, as well as sub-bituminous coals and lignite. It has been notably successful in burning the lower-priced poorer grades of coal which are so difficult to burn satisfactorily on other types of stokers.

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

. . . . Choice of industry after industry

Why has the Package Boiler been selected by such widely varying industries as those listed?

BALANCED DESIGN

BECAUSE it has not one or two features for special needs, but a *completely balanced design* that adapts itself to many conditions . . . a design in which each element is coordinated with every other for top performance.

EFFICIENT PERFORMANCE

BECAUSE the C-E Package Boiler has high efficiency over a wide range of output and responds to rapid load swings . . . characteristics especially advantageous in many industrial plants.

EASY OPERATION

BECAUSE the C-E Package Boiler is simple to operate and maintain at peak efficiency — a boon to plants having limited personnel.

CHOICE OF FUELS AND FIRING

BECAUSE in addition to its wide adaptability, the C-E Package Boiler permits you to choose the one *best* method of firing for the fuel and load conditions of *your* plant.

LOWER COST

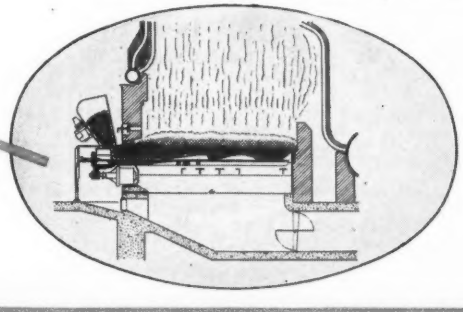
BECAUSE the standardized balanced design of the C-E Package Boiler effects economies in engineering, fabrication, and erection which are passed on to you in lower first cost.

UNIFIED RESPONSIBILITY

BECAUSE the C-E Package Boiler is a complete unit . . . boiler, furnace setting, fuel-burning equipment, controls, forced draft . . . giving you the added benefit of *one contract, one guarantee* and *one responsibility.*

• • •

Small wonder so many diverse industries select the C-E Package Boiler. If your requirements fall within the available capacity range, let C-E engineers match your needs to Package Boiler performance. B-231



TYPE E UNDERFEED STOKER — Designed to burn both caking and non-caking bituminous coals, the Type E Stoker is one of the oldest and best-known stokers in America. Sound design, rugged construction and fine performance have made the Type E Stoker the recognized leader in its field.

PARTIAL LIST OF INDUSTRIES THAT HAVE SELECTED THE C-E PACKAGE BOILER

AUTOMOBILE
BAKERY
CHEMICAL
COLD STORAGE
DAIRY
GLASS
HOSIERY
HOSPITAL
INSTITUTIONS
LEATHER
LINOLEUM
MACHINERY
METALS
OIL
PACKING
PAINTS
PAPER
RAILROADS
RUBBER
STEEL
SUGAR
TEXTILE
TOBACCO
UTILITY

ENGINEERING

200 MADISON AVENUE, NEW YORK 16, N. Y.

for EVERY

Yarway Type "B" angle-straightway Seatless Tandem Valve with balanced sliding plungers. Flanged, steel body.

Yarway Type "C" angle-straightway Seatless Tandem Valve with balanced sliding plungers. Flanged, steel body.

THERE'S A YARWAY BLOW-OFF VALVE

Yarway offers boiler plant operators a complete Blow-Off Valve Service—distinct types of valves to meet the blow-down requirements of every steam plant.

These valves are the products of 40 years mechanical and metallurgical research—of practical field experience with thousands of installations—of experiments and testing in Yarway's own unique Steam Laboratory—and of a determination continually to lead the industry with the finest blow-down equipment that can be produced.

Because the Yarway line is complete you may be sure Yarway recommendations are based on experienced judgment that the type of valve selected will give long, trouble-free, money-saving service.

WRITE TO YARWAY FOR FREE BLOW-OFF VALVE BULLETINS. STATE YOUR BOILER PRESSURE.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

YARWAY BLOW-OFF V

PRESSURE

Yarway Unit Tandem Valve combining a Yarway Hard-Seat Valve (for blowing) and a Yarway Seatless Valve (for sealing) in a one-piece forged steel body. Flanged connections shown. Two Hard-Seat Valves furnished if desired.

TO 2500 PSI

A Few Representative Users

OF YARWAY BLOW-OFF VALVES

UTILITIES

Philadelphia Electric Co.
Boston Edison Co.
Pacific Gas & Electric Co.
Pennsylvania Power & Light Co.
Georgia Power Co.
Cleveland Elec. Illuminating Co.
Connecticut Light & Power Co.
Indiana-Michigan Power Co.

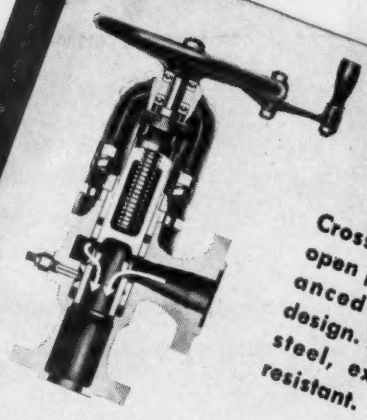
INSTITUTIONS

University of Michigan
Harvard Medical School
Florida State Hospital
California State Hospital
University of Chicago
Cornell University
Kentucky State Hospital
Iowa State College

INDUSTRIAL PLANTS

Celanese Corp.
R. J. Reynolds Tobacco Co.
Eastman Kodak Co.
Armour & Co.
American Viscose Co.
Lever Bros. Co.
Armstrong Cork Co.
Bethlehem Steel Co.

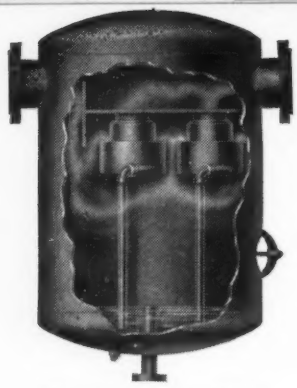
Forty Years SERVICE
1908 YARWAY 1948
TO STEAM PLANTS



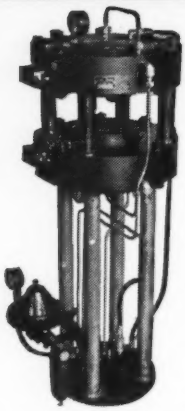
YARWAY SEATLESS ANGLE VALVE
Cross section of valve in open position. Notice balanced sliding plunger design. Plunger is nitrided steel, extremely wear-resistant.

YARWAY HARD-SEAT STRAIGHTWAY VALVE
Cross section of valve in open position. Stellited disc and seat. A worthy companion to the Yarway Seatless Valve for tandem use on higher pressure.

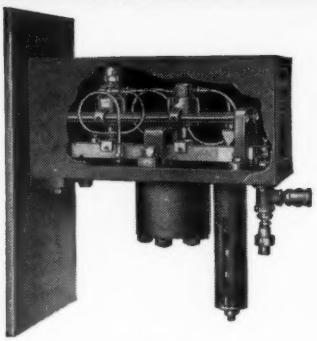
F VALVES



STEAM SEPARATOR



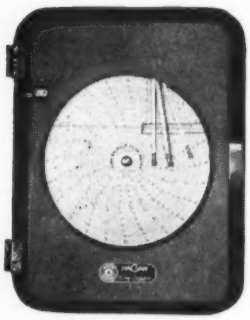
HAGAN THRUSTORQ



TYPE "F"
MASTER SENDER

RATIO RELAY

RING BALANCE
FLOW METER
(Indicating, Integrating
& Recording)



RING BALANCE
FLOW METER
(Integrating & Recording)

Typical applications for

This partial list, and accompanying photographs are published to remind you that Hagan service is broader than the automatic combustion control systems which are usually associated with the Hagan name.

Control of combustion rate of boilers

Constant or graduated draft control

Constant or graduated pressure control

Feeder or stoker speed control

Control of multiple fuel firing

Fan speed control

Pump speed control

Hydraulic coupling control from speed or delivery of driven unit

Constant differential pressure control (liquids or gases)

Accurate control of position from remote point

Control of steam, gas, and liquid pressures

Measurement of steam, gas and liquid pressures

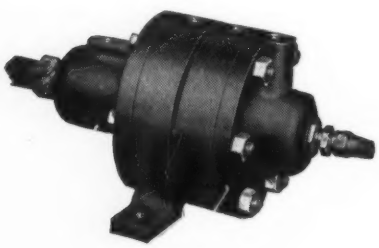
Control of pump discharge pressure and flow

Steam flow control

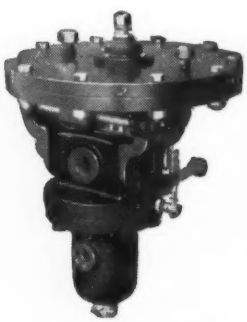
Steam pressure reduction and desuperheating control

Steam temperature control (superheat)

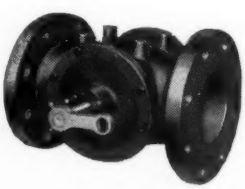
Removal of oil, moisture and solids from exhaust steam



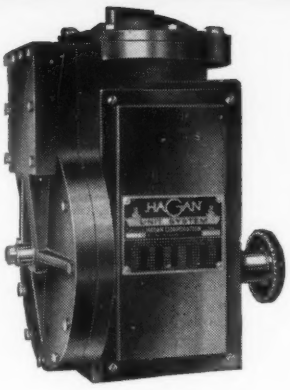
TYPE "F"
TOTALIZER



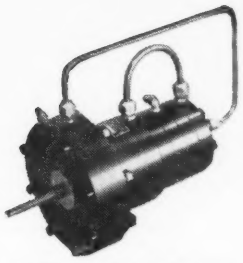
DIFFERENTIAL
TRANSFORMER



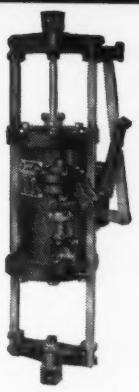
V PORT
BUTTERFLY
VALVE



VARIABLE
RATIO REGULATOR



MICRO-POSITIONER



RECEIVING
REGULATOR

DIAPHRAGM
REGULATOR

HAGAN *equipment*

- Removal of oil and moisture from compressed air
- Control of separately fired superheaters
- Flow control (liquids and gases)
- Flow measurement of liquids and gases with pressure and temperature compensation
- Gas mixing control
- Fuel-air ratio control
- High temperature regulation
- Remote manual or automatic control
- Recovery of steam from continuous blowdown systems
- Program control
- Oil burner control
- By-pass damper control for air preheaters
- Feed water heater pressure and temperature control
- Liquid level control
- Control of multi-speed motor drives
- Safety protection for gas or pulverized coal firing
- Steam jet refrigeration control
- Force measurement and control
- Measurement and control of thrust and torque

We will be glad to supply full information concerning any of these applications or pieces of equipment.

Hagan Corporation, Hagan Building, Pittsburgh 30, *Pa.*

THERMOSTAT

HAGAN
HALL
BUROMIN
CALGON

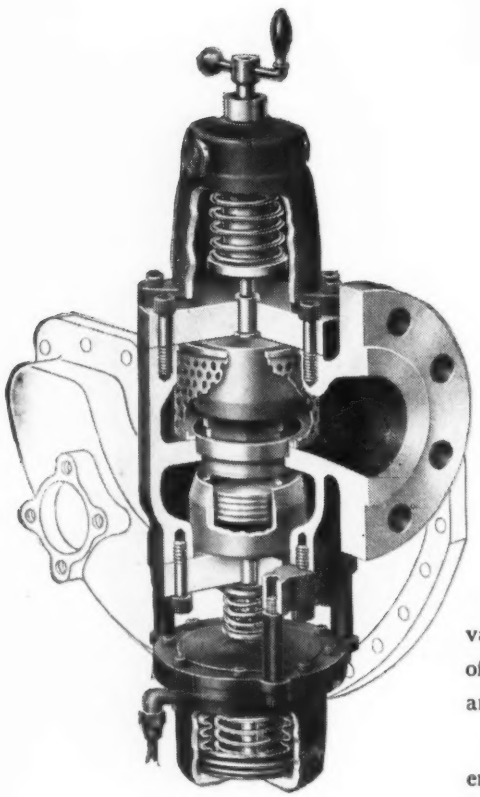
HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

THE new G-E standard mechanical-drive turbine—the Type DP—is a machine designed by turbine *users*. This new design was undertaken after an exhaustive survey, covering hundreds of turbine users, indicated the features *you* rated most desirable.

Formerly most of these features were obtainable at a price addition in a "special" machine. Now, as a result of superior design and greater standardization, we offer these special features as standard equipment —at no extra cost. This, we believe, makes the new Type DP the greatest value in small turbine history!

NEW TURBINE OFFERS AT NO EXTRA



FOR THE FULL STORY

If you have steam available, these *new* turbines can work profitably for you. G-E sales engineers and turbine specialists will be glad to show you how your equipment can benefit from the features of G-E turbine drive. And, their wide experience is at your disposal.

For full information please contact the nearest G-E Apparatus Sales Office. Or, write today for GEA-4955, a fully illustrated, 20-page descriptive bulletin. Apparatus Department, General Electric Company, Schenectady 5, N. Y.

For many applications the combined trip-throttle valve—an exclusive G-E feature—makes a separate shut-off valve unnecessary, saves you the cost of purchasing an extra valve.

The trip-throttle valve and the governing valve are an entirely new balanced reaction design, requiring very little force to operate. No soft packings are used.

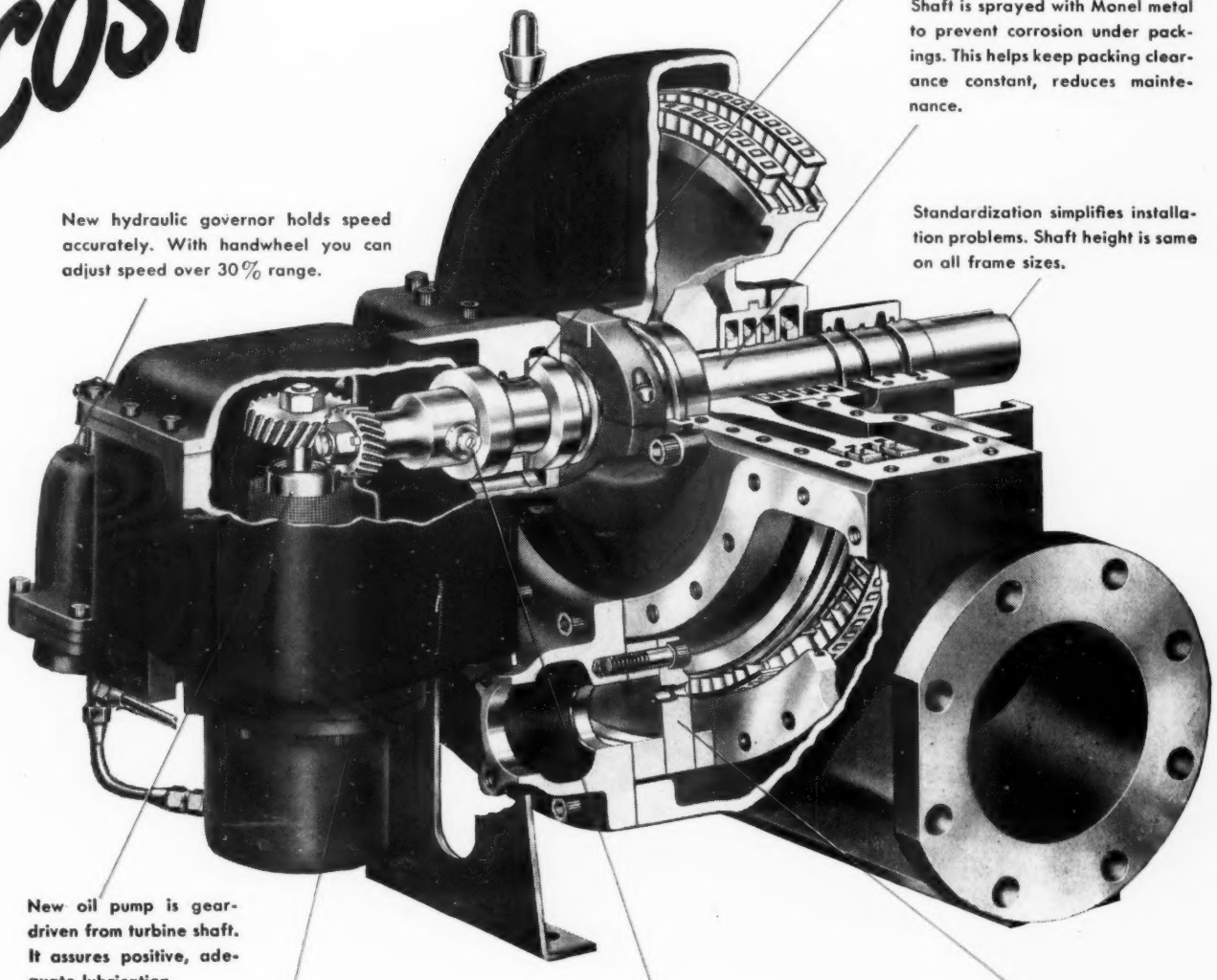
YOU SPECIAL FEATURES COST

New solid-backed bearings wear better, last longer. Thrust surfaces accurately position rotor, prevent misalignment troubles.

Shaft is sprayed with Monel metal to prevent corrosion under packings. This helps keep packing clearance constant, reduces maintenance.

New hydraulic governor holds speed accurately. With handwheel you can adjust speed over 30% range.

Standardization simplifies installation problems. Shaft height is same on all frame sizes.



New oil pump is gear-driven from turbine shaft. It assures positive, adequate lubrication.

New oil cooler assures positive cooling of lubricating oil, reduces chances of bearing failure. Cooler is readily accessible, easily removed.

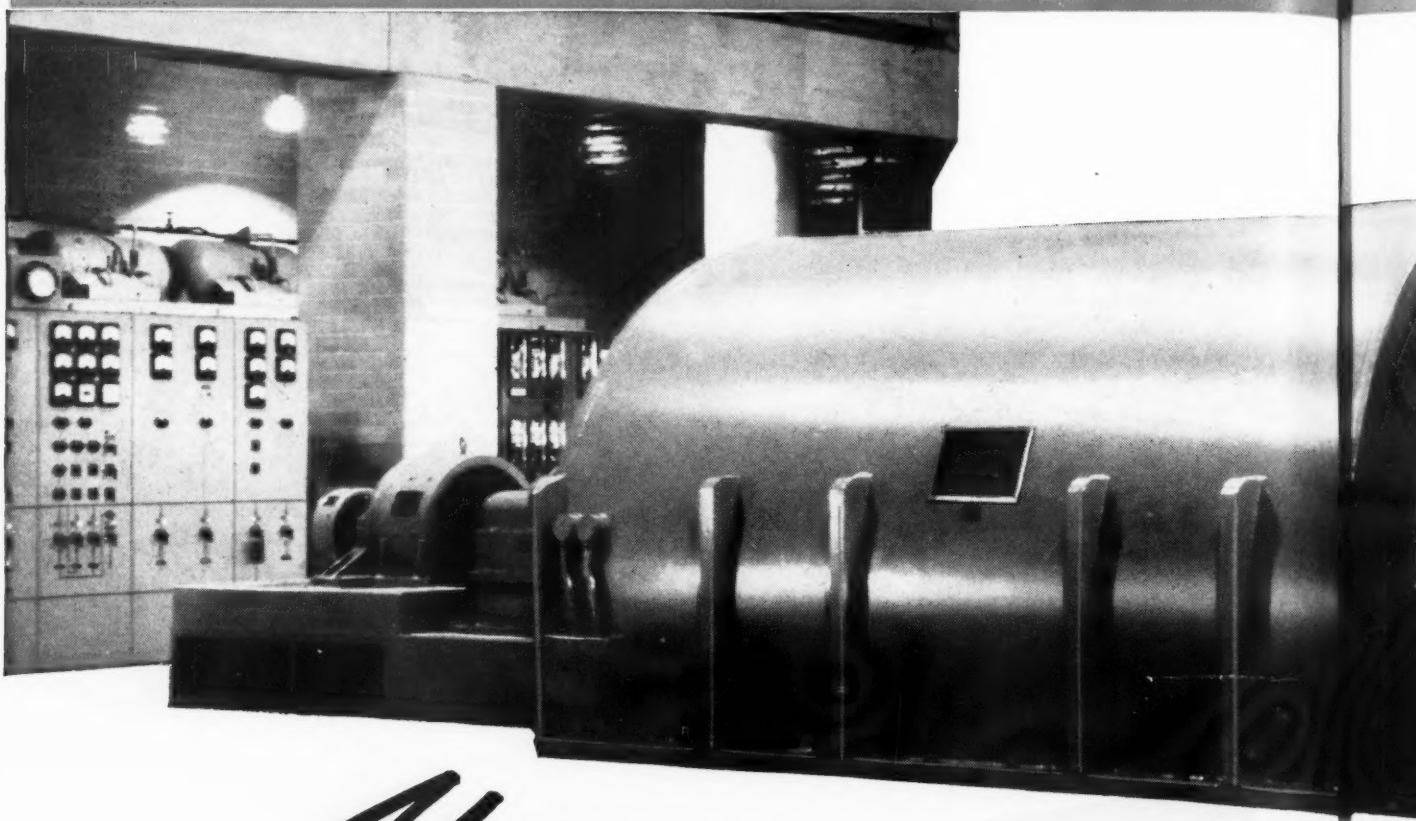
New nonsparking emergency governor assures positive overspeed protection. It is totally enclosed in an oil atmosphere, thus not subject to rusting or sticking.

Nozzle plate is made of special steel to resist corrosion and erosion. Thus high efficiency of your turbine will be maintained.

GENERAL ELECTRIC

252-27

TURBINES MUST



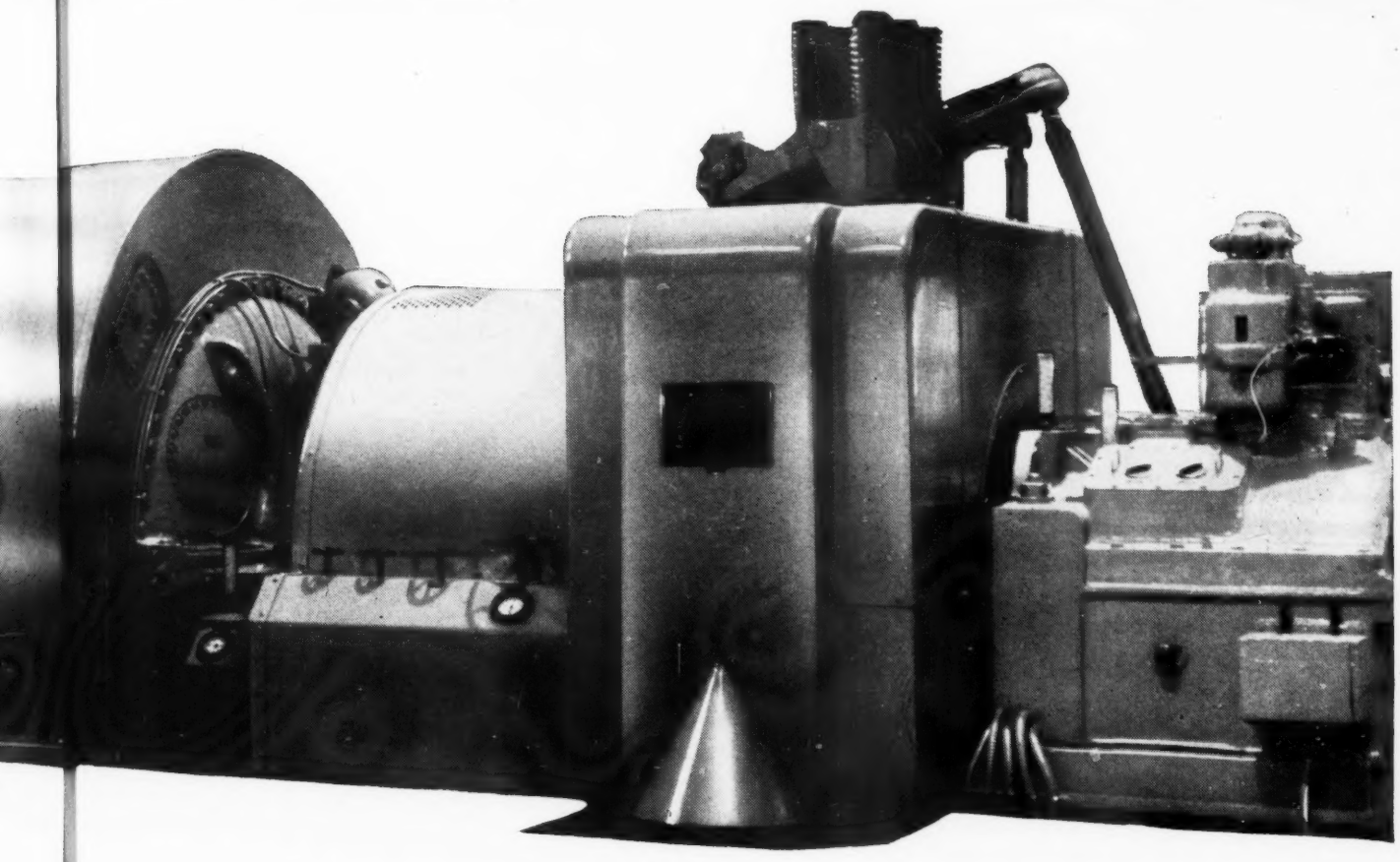
...Use SINTURLITE OIL

Time out needed for cleaning or changing turbine oil is greatly reduced when Sinclair SINTURLITE is the lubricant. With SINTURLITE OIL on the job the circulating oil flows freely...continuously...keeps new oil qualities and delivers full lubricating value year in and year out.

SINCLAIR

YOUR NEAREST SINCLAIR AGENT WILL GLADLY ARRANGE

BE KEPT GOING

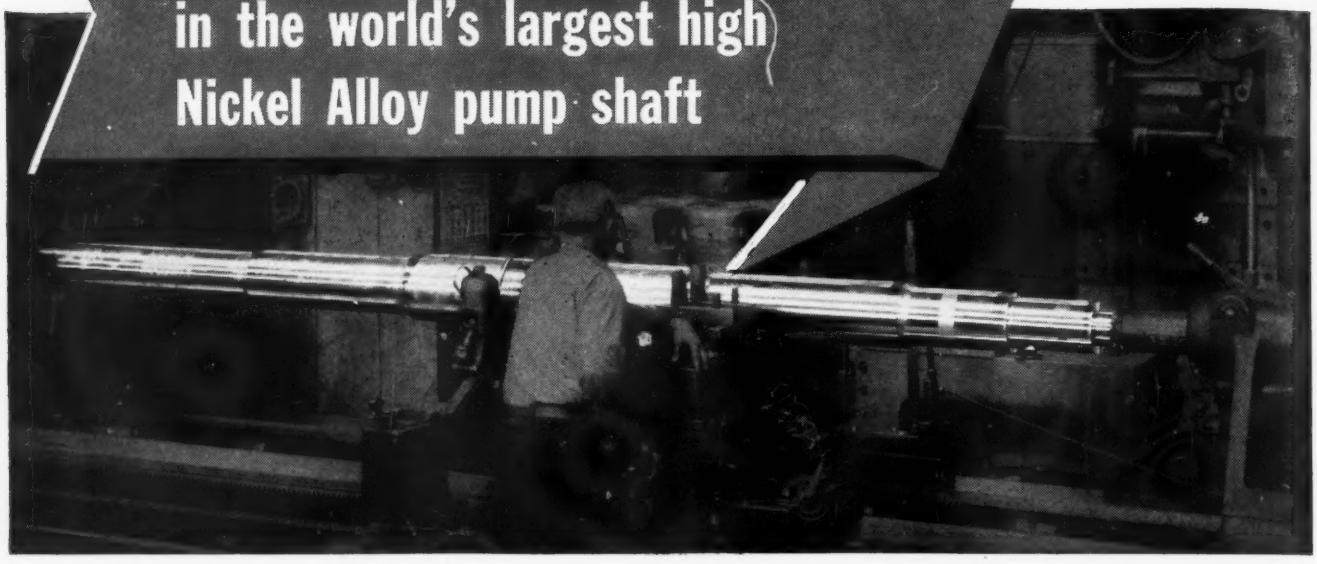


Sinclair SINTURLITE OILS have set an enviable performance record for standing up in the grueling day in and day out grind of continuous turbine service. SINTURLITE'S inherent high oxidation stability is strengthened by proven additives. Sludge formation and acid value are checked. Protection against rust trouble is assured because SINTURLITE OILS are rust inhibited. All the lubricating requirements prescribed by the turbine builders are provided by SINTURLITE—with margins to spare. Try SINTURLITE in your turbines.

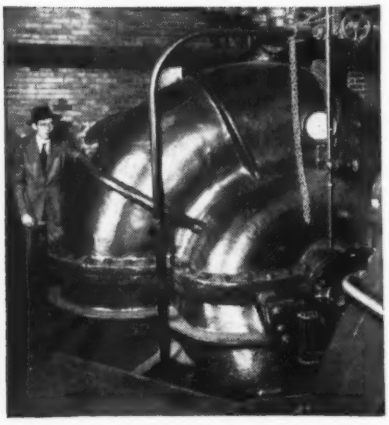
INDUSTRIAL OILS

FOR LUBRICATION COUNSEL, OR YOU MAY WRITE TO SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

Why Consolidated Edison invested in the world's largest high Nickel Alloy pump shaft



World's largest high nickel alloy pump shaft. It was forged at INCO's Huntington, W. Va. mill, and machined by the Ingersoll-Rand Company, Phillipsburg, N. J. The forging weighed 3343 pounds. The shaft's finished dimensions were: length, 13 ft. 7⅛ in.; diameter, 9.005 in.



One of two huge centrifugal pumps installed at the 14th Street plant of the Consolidated Edison Company of New York. The pumps were built by the Ingersoll-Rand Company.

In the 14th Street plant of the Consolidated Edison Company of New York, there are two large condenser circulating pumps. They are giants of their kind, together handling 160,000 gallons of water every minute. But for 19 years, they have been ailing. The cause of their malady is the polluted salt water they pump from New York's East River. Corrosive action, plus fatigue caused repeated failures of the pump shafts.

The shafts originally installed were mild steel. These failed in relatively short time, and were replaced by others of the same metal. When these, too, failed, alloy steel shafts were tried. But these fared little better, and Consolidated Edison engineers decided the time had come to stop experimenting with metals that were not sufficiently resistant to corrosion and fatigue.

From their own experience with Monel* shafts in smaller pumps, and knowing that Monel and "K"* Monel are U. S. Navy standard metals for salt water pump shafts, the Consolidated Edison Company selected "K" Monel for this important job. This heat treatable grade of Monel provides extra strength, stiffness, and hardness for bearing surfaces.

The Consolidated Edison Company expects long and trouble-free service from this new shaft, because MONEL has the necessary combination of properties to withstand severe stress-corrosion conditions. MONEL is rustproof, corrosion-resistant, tough, and stronger than most structural steels.

INCO Nickel Alloys can extend the life of your pumps, valves, gaskets, packing, tanks, heat exchangers, and other equipment. For help in solving your power plant corrosion problems, write for "Individualized INCO Nickel Alloys." It is free.

THE INTERNATIONAL NICKEL COMPANY, INC.

67 WALL STREET, NEW YORK 5, N. Y.

EMBLEM OF SERVICE
NICKEL INCO TRADE MARK ALLOYS

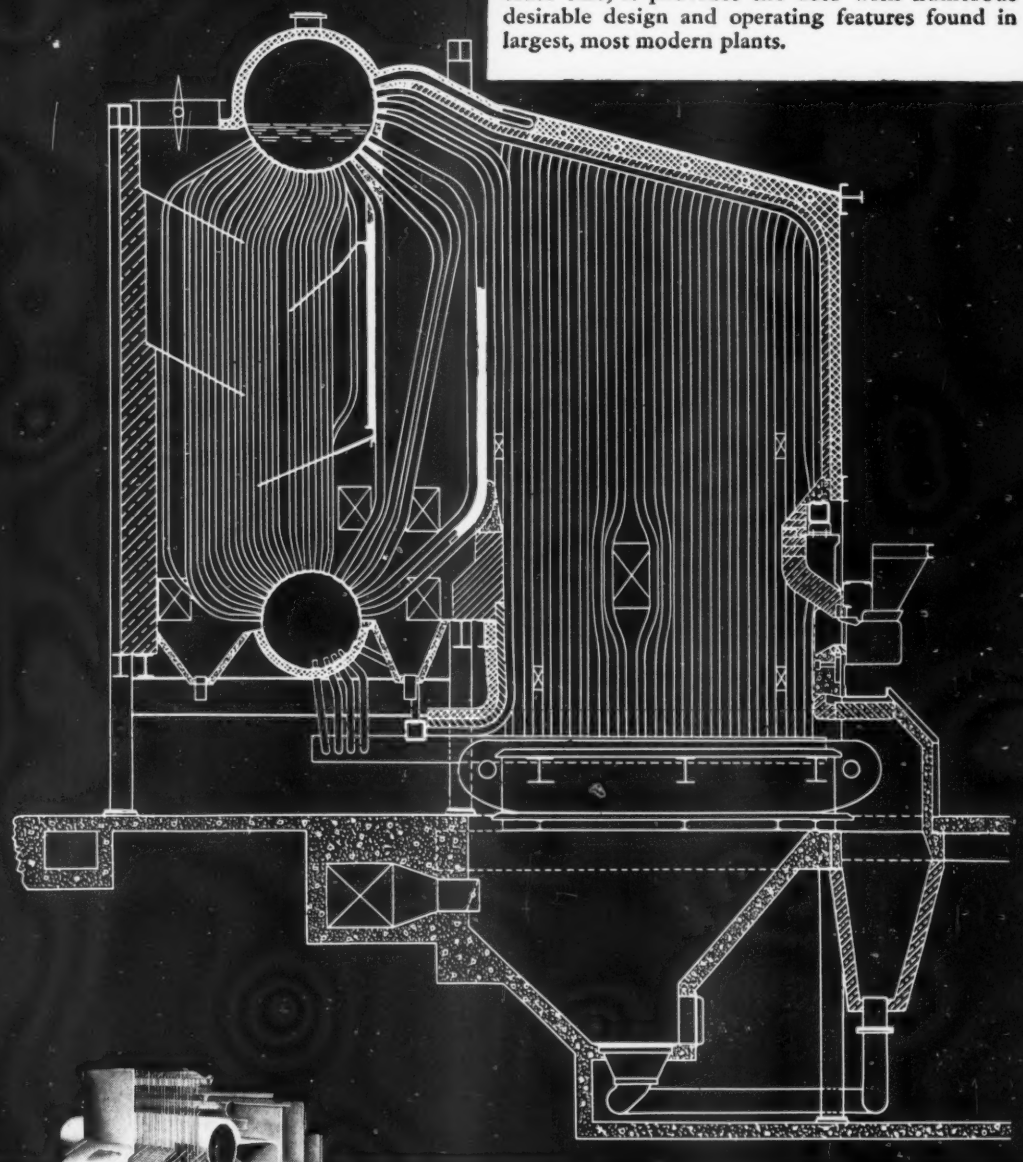
MONEL* • "K"* MONEL • "S"* MONEL • "R"* MONEL • "KR"* MONEL
INCONEL* • NICKEL • "L"* NICKEL • "Z"* NICKEL

*Reg. U. S. Pat. Off.

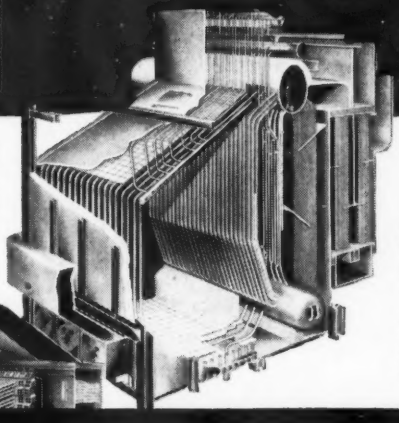
"To Meet User's Needs"

Location:
SANGAMO ELECTRIC CO.
Springfield, Ill.

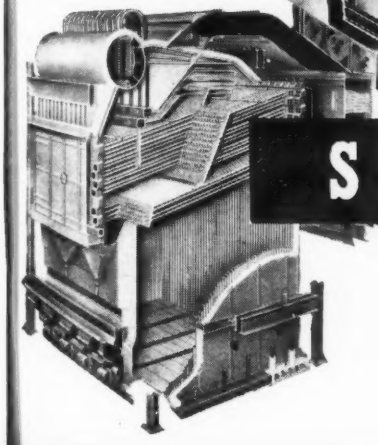
HERE is another example of a new two drum steam generator by Springfield that has been designed to meet the user's particular requirements. It is equipped to operate on Illinois coals with continuous ash discharge spreader stoker. Occupying less than 300 sq. ft. of floor space, the unit will produce 30,000 lbs. of steam per hour at an operating pressure of 150 p.s.i. Although of only moderate size, it provides the user with numerous desirable design and operating features found in largest, most modern plants.



SPRINGFIELD BOILERS



CHECK WITH YOUR CONSULTING ENGINEER ON YOUR MODERNIZATION AND NEW PLANT PROJECTS



SPRINGFIELD PRODUCTS

BENT TUBE STEAM GENERATORS—Modern designs for capacities from 10,000 lbs. up.

STRAIGHT TUBE BOILERS—Specially designed for capacities from 5,000 to 450,000 lbs. per hour and higher.

STANDARDIZED TYPE M BOILERS—Standardized for quicker delivery and lower cost. Sizes 6,000 to 17,000 lbs. per hour.

WATER COOLED FURNACES—Heavy duty water walls. Exclusive center water wall construction for larger units.

SUPERHEATERS — AIR HEATERS — ECONOMIZERS—Individually designed to meet requirements.

SPRINGFIELD BOILER CO.

1953 E. Capitol Ave. Springfield, Illinois

WORLDWIDE SALES AND SERVICE

NEW YORK • PHILADELPHIA • WASHINGTON, D. C. • DETROIT • SALEM, MASS. • HOUSTON
CHICAGO • SAN FRANCISCO • ST. LOUIS • CINCINNATI • MEXICO, D. F. • BUENOS AIRES

Export: READING, PA.

Good Equipment, Correctly Applied!

THAT IS THE BASIS of effective conditioning of boiler feedwater makeup . . .

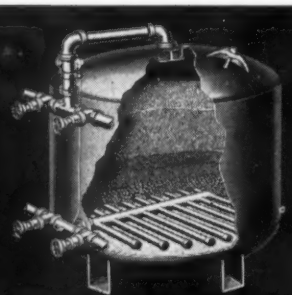
Long experience in conditioning boiler water in thousands of high and low pressure power plants qualifies Allis-Chalmers to assist you in selecting the *best* process and the *right* equipment for your plant.

Allis-Chalmers recommendations are unbiased because they provide a *complete* line of water conditioning equipment including Hot and Cold Process Softeners, Sodium and Hydrogen Zeolite Softeners, Degasifiers, Deionizers, Chemical Proportioners, and Oil Removal and Water Filters.

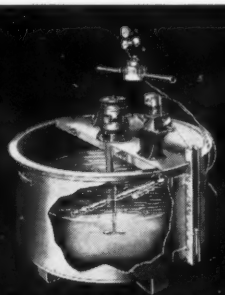
For prompt help, call your nearest A-C office or write: ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

★ ★ ★

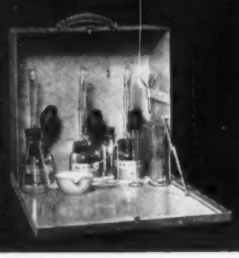
Illustrated below are component parts of Allis-Chalmers Hot Process Lime-Soda Softening System. Bulletin 28B6611 offers complete details. A 2340



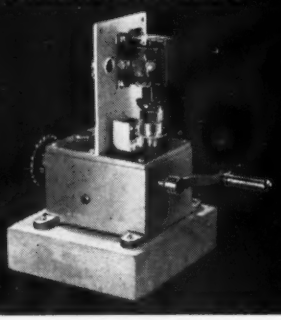
FILTER TANK with water collecting and distributing system designed to insure uniform flow through graded filter bed.



CHEMICAL MIXING tank with proportioning assembly and agitator. Assures complete mixing and precise feeding of chemicals.



TEST KIT for treated water analysis and making adjustments in chemical treatment when composition of raw water varies.



ELECTRO-MAGNETIC proportioner with dust-proof cover removed. Vernier adjustment permits micro-control of chemicals fed.

SOFTENER TANK constructed to provide proper flow velocities for effective chemical reaction and sludge sedimentation.

ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment—Biggest of All in Range of Industrial Products

Super-Market for PIPING

● **A GRINNELL WAREHOUSE** can be your *one supplier* of piping . . . a dependable source for *all* your requirements.

In addition to the broad line of Grinnell-manufactured piping products, each Grinnell Warehouse carries a complete stock of pipe, valves, and piping specialties . . . and can help you engineer your piping system. You save time and money when you "shop" at Grinnell.

Take advantage of this *complete* piping service . . . call on Grinnell "whenever piping is involved".

GRINNELL OFFERS A COMPLETE PIPING SERVICE

PIPING SUPPLIES

- Pipe, Valves and Fittings
- Engineered Pipe Hangers
- Grinnell-Saunders Diaphragm Valves
- Thermolier Unit Heaters
- Prefabricated Piping
- Plumbing and Heating Specialties
- Oil, Water Works and Industrial Piping Supplies

OTHER GRINNELL PRODUCTS

Automatic Sprinklers and Special Hazard Fire Protection Systems

AMCO Humidification and Cooling Systems

GRINNELL COMPANY, INC.
Executive Offices
PROVIDENCE 1, RHODE ISLAND

GRINNELL

WHENEVER **PIPING** IS INVOLVED

The Trinidad Station is the base load station of the Texas Power and Light Company which gives uninterrupted service to industrial, commercial, and residential consumers over an area of approximately 47,000 square miles. Four Foster Wheeler condensers are installed here. A fifth, almost twice the size of the one shown on the opposite page, is now being built to serve the station's newest and largest turbo-generator. With this new turbo-generator, Trinidad will have a capability of 241,000 horsepower, enough to supply the power and light needs of a city of 1,000,000 in population.

Foster Wheeler Condensers Meet Specifications

That is why the Texas Power and Light Company purchased another Foster Wheeler condenser for its Trinidad Station.

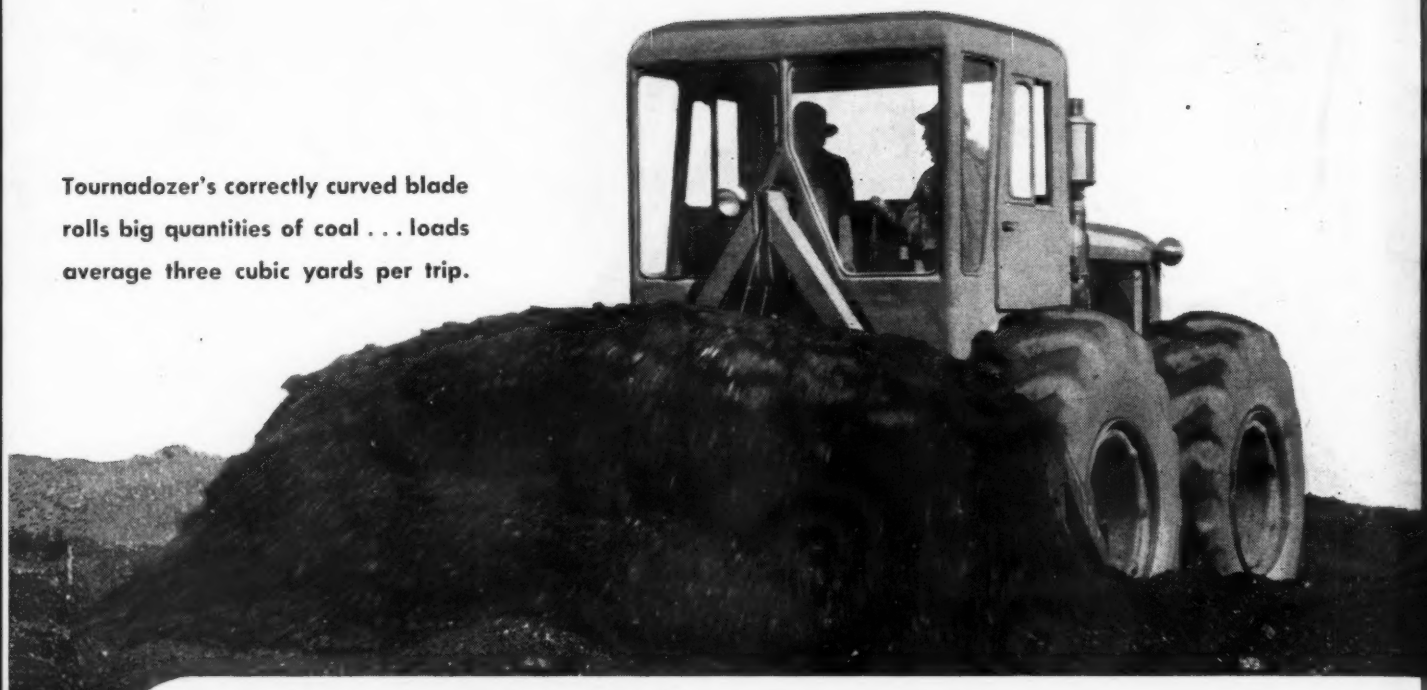
No. 4 Unit at Trinidad—28,000 sq. ft.—serving a 40,000 kw turbine

This cross-flow condenser was installed at the Trinidad Station a few years ago. It is a single-pass, non-divided water box unit. Auxiliary equipment includes a twin steam jet air ejector, two condensate pumps, and two circulating pumps.

FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, NEW YORK

FOSTER WHEELER

TOURNADOZER



Tournadozer's correctly curved blade rolls big quantities of coal . . . loads average three cubic yards per trip.

Contractor Sam Falbo, of Lorain, Ohio, is using a high-speed, rubber-tired C Tournadozer, operating 24 hours a day 7 days a week, to position and compact coal on stockpile for big Ohio industrial firm. Actual job production studies show Tournadozer averages 116.4 cubic yards per hour on 300' cycles . . . that's 1 minute and 29 seconds per cycle. Especially valuable is Tournadozer's ability to go anywhere on the property or travel job-to-job at speeds up to 15 m.p.h.

Rubber tires reduce fire hazard

In addition, Tournadozer's giant rubber tires leave a hard-packed surface behind them . . . give good coal compaction to reduce the possibility of spontaneous combustion . . . do not kick up the surface of the coal.

Doubles crawler output

Operator Melvin Stevens says, "I always doze coal in 2nd or 3rd gear . . . make 3 trips to a tractor's one and get more coal in one load than a crawler can get in two.

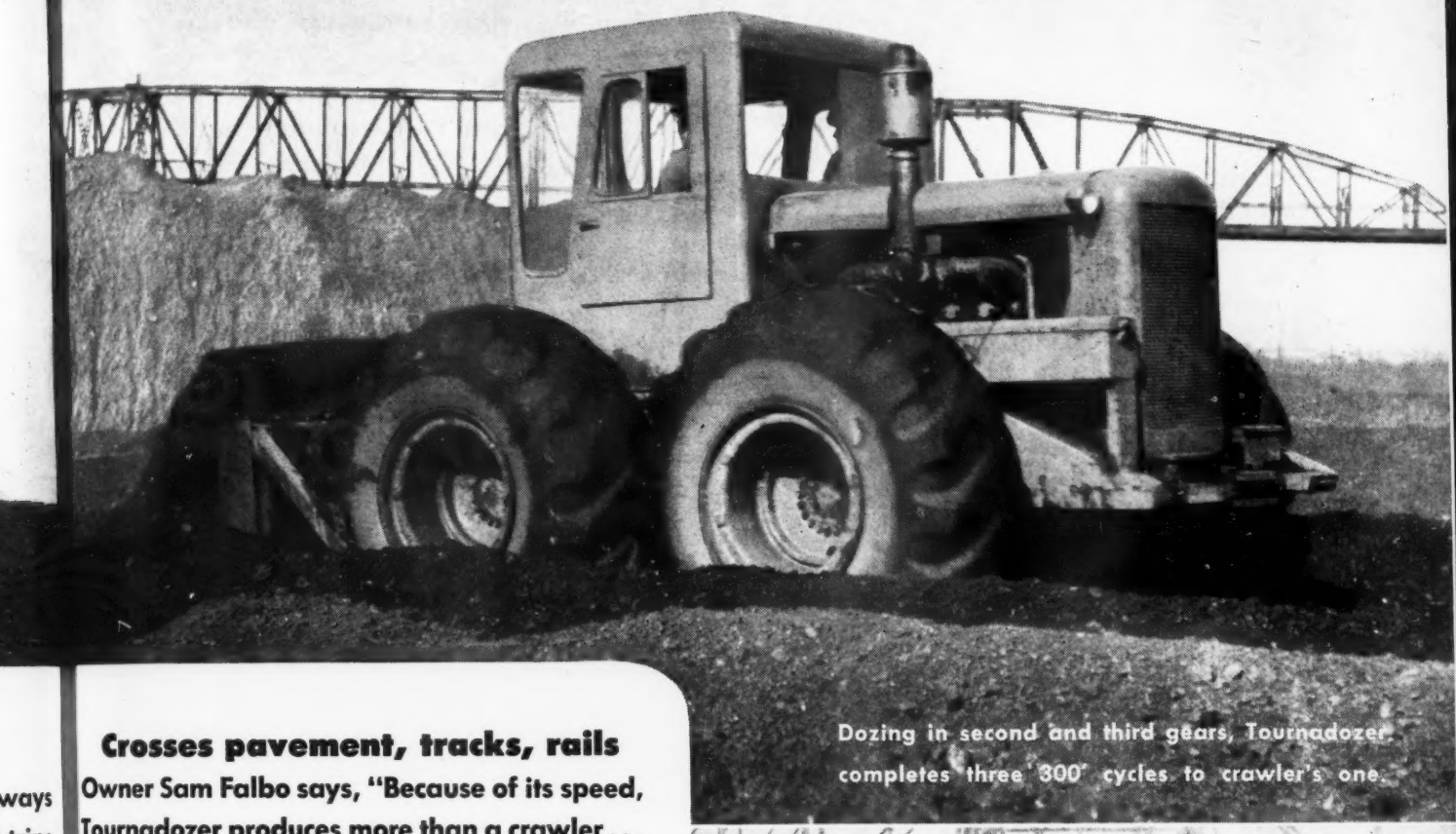
"Crossing ridges of coal on a track-type dozer you can hardly stay on the seat. I go over them with Tournadozer and there is hardly any jar . . . it's faster and easier to operate. Another thing, you don't have to pull your guts out to steer it. I sure wouldn't trade it for any crawler.

"Last winter we used Tournadozer to haul tractors into the plant on a low-boy when trucks couldn't make it through ice and snow. I take our Tournadozer back to our warehouse every evening, over concrete highway."

LETOURNEAU LET EQUIPMENT

It's RUBBER THAT PUTS THE ACTION IN TRACTION . . . See your LeTourneau Distributor NOW for complete information

tockpiles 116 cubic yards an hour for Ohio steel mill



Dozing in second and third gears, Tournadozer completes three 300' cycles to crawler's one.

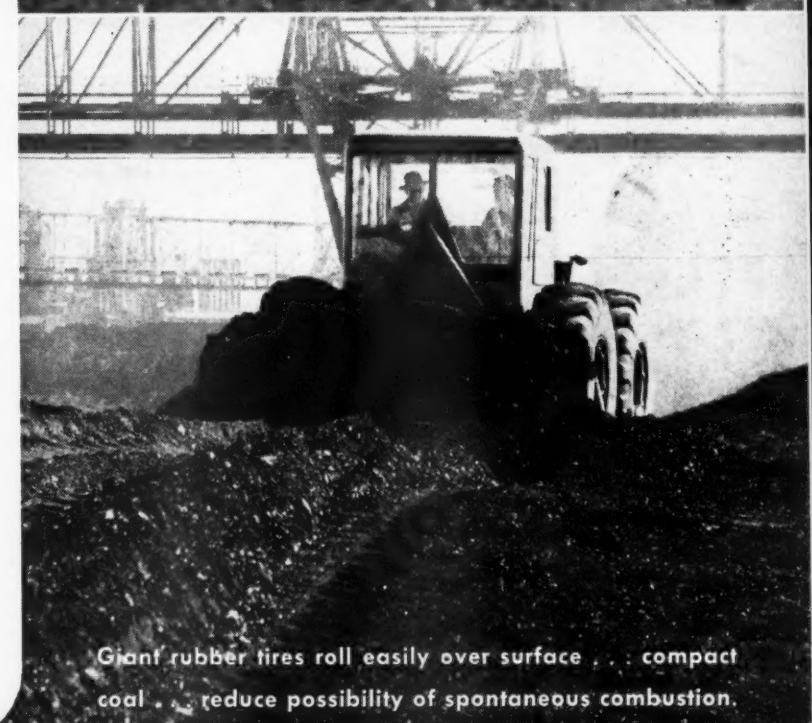
Crosses pavement, tracks, rails

Owner Sam Falbo says, "Because of its speed, Tournadozer produces more than a crawler . . . does a good job . . . crosses anything: tracks, pavements, rails, etc., without damage . . . they even use it to switch railroad cars."

All-around utility dozer

On average dozing jobs, Tournadozer is going to give you more than double the production of crawler-dozers. Constant-mesh Tournamatic transmission gives you speeds up to 15 m.p.h. forward and REVERSE. Instantaneous speed selection turns shifting time into production time. Tournadozer can travel 100' in 3rd gear, forward or reverse, at speed of 7 m.p.h. in the 10 seconds it takes a crawler to shift gears.

Tournadozer-Tournamatic-Trademark CH-7



Giant rubber tires roll easily over surface . . . compact coal . . . reduce possibility of spontaneous combustion.

TOURNEAU
PEORIA, ILLINOIS

HIGH-SPEED RUBBER-TIRED

TOURNADOZERS

For Lowest-Cost Fuel Handling

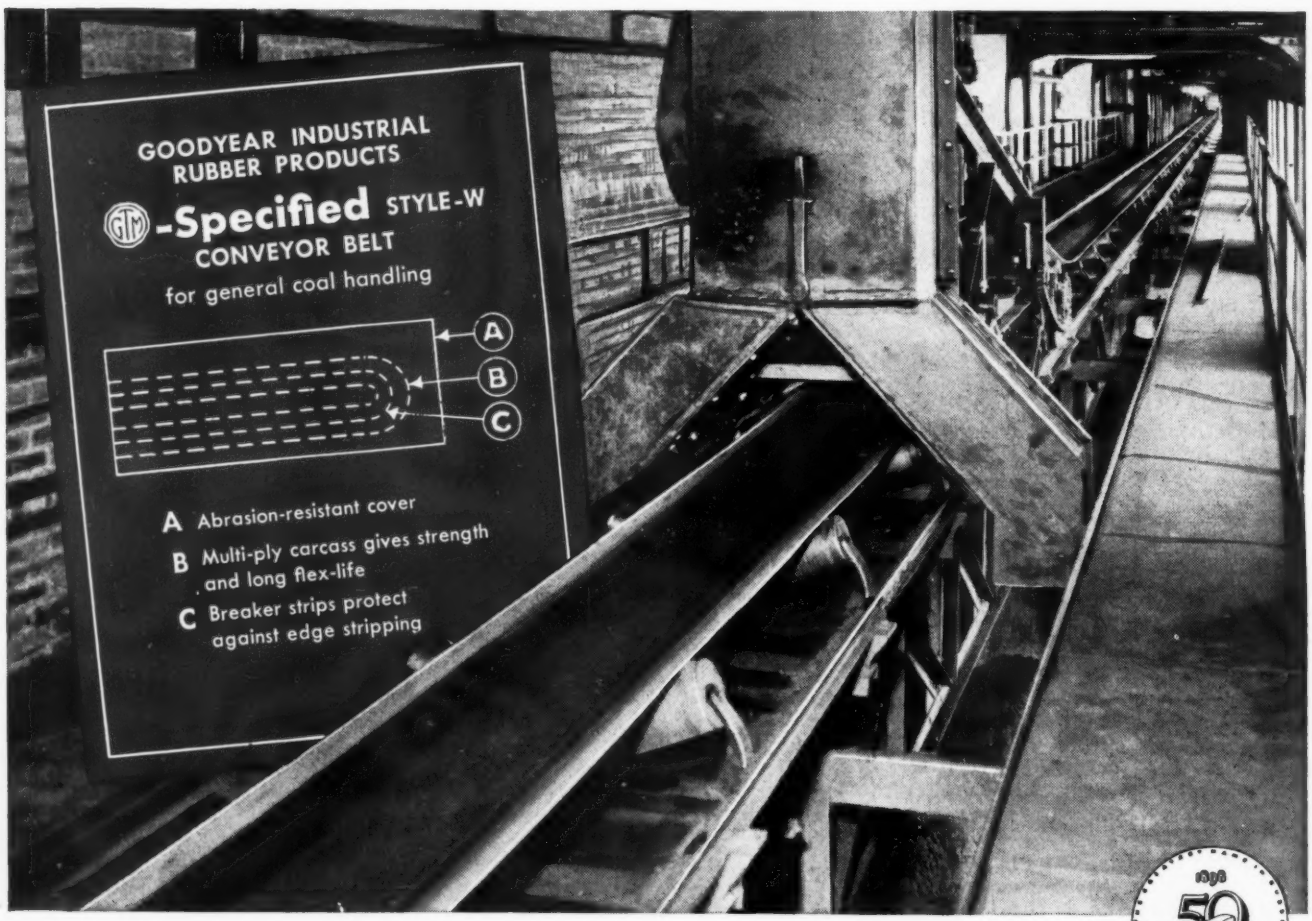
Specify GOODYEAR Belts

WHATEVER kind of coal you feed your boilers, you can handle it better—quicker—and at lower cost with Goodyear conveyor belts—from stock pile or unloading point to crusher to bunker.

Here's why. When you order a belt from the G.T.M.—Goodyear Technical Man—he draws on the experience of the world's largest maker of conveyor belts to specify the exact equipment for your needs—the belt that will handle *more* coal for *longer* periods at *less* cost.

The number of revolutions per hour, the frequency and severity of abrasion and flexing, the magnitude of impact to be absorbed by the belts, the physical and chemical properties of the material to be conveyed—all these influence the G.T.M. in the selection of the proper belt to meet your needs. That's why Goodyear belts now in service have carried as much as 45,000,000 tons of coal—why a G.T.M.-specified fuel conveyor belt means lower-cost fuel handling—lower belt cost—higher plant efficiency at the bunker end.

Why not get in touch with the G.T.M. today? Call your nearest distributor of Goodyear Industrial Rubber Products, or write Goodyear, Akron 16, Ohio.

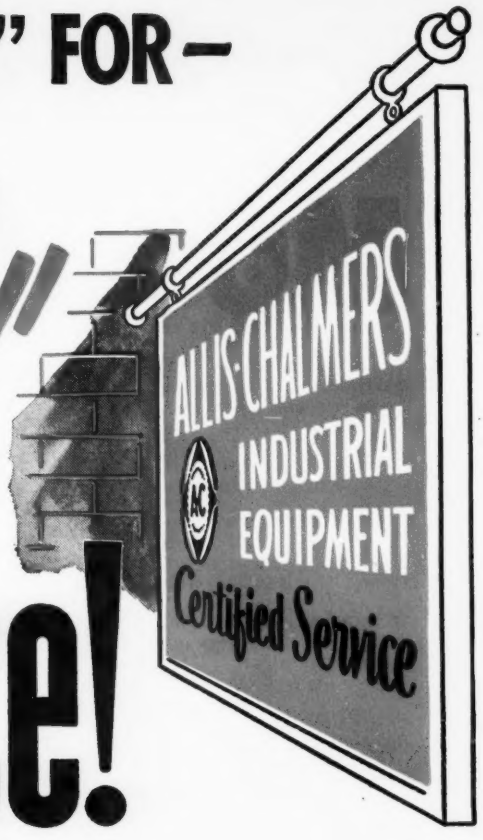


GOODYEAR

THE GREATEST NAME IN RUBBER

SPECIFY "ALLIS-CHALMERS" FOR—

"Certified" Motor Service!



Independent Local Repair Shops Now Being Selected to Give Better, Faster Service — "Certified" Parts and Workmanship—on Allis-Chalmers Motors— Transformers — Controls — and Pumps!

THE NAME "ALLIS-CHALMERS" has always meant good motors, generously built for long life! Now you have an *added* reason for investing in Allis-Chalmers motors . . .

BETTER SERVICE

Throughout the U. S. qualified motor repair shops are being selected and authorized as Allis-Chalmers *"Certified"* Service Shops. Each will have trained personnel as well as complete facilities for servicing and repairing Allis-Chalmers motors to original factory-established standards!

"CERTIFIED" Service Benefits You These Ways:

YOU GET FINEST PARTS. *"Certified"* Service Shops use genuine Allis-Chalmers repair parts — or parts of equal quality! Each shop is given complete service information, including factory procedure and drawings, if necessary. Result: factory-like workmanship!

YOU GET FINEST SERVICE. Every Allis-Chalmers *"Certified"* Service Shop has been selected on the basis of its excellent reputation in the community. It's the kind of shop you *like* to do business with!

How To Get Allis-Chalmers "CERTIFIED" Service:

Right now most Allis-Chalmers *"Certified"* Service Shops are located in the larger U.S. industrial areas. But they're rapidly expanding. For service, call your nearby A-C District Office, or Authorized Dealer. If we do not have a Service Shop in your locality, we will recommend the one closest to you. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN. A 2498

NEW MOTORS AVAILABLE!

Many Sizes and Ratings of Allis-Chalmers Standard Squirrel-Cage Motors from 1 hp up are Now Available from Stock. Call Your A-C Authorized Dealer or District Office.

ALLIS-CHALMERS

One of the Big 3 in Electric Power Equipment—Biggest of All in Range of Industrial Products

PREVENT COSTLY MOTOR BURNOUTS *With* BUSS FUSETRONS

Here's the Experience of a Large Steel Mill -

"The rolls on the roll out table are driven by individual variable speed motors. These motors frequently stall and of course burn out very quickly on locked rotor. The result was that formerly two motor repairmen were kept constantly busy rewinding the motors from the roll out table.

"We installed Fusetrons of motor protection size to protect each motor. Motor burnouts were eliminated at once and the two workmen who formerly spent full time rewinding motors were assigned to other jobs in the mill. After three years of operation, our electrical foreman reports that the only motor repairs now experienced on the roll out table are due to burned out bearings. He now considers every blown Fusetron means another motor saved from burnout.

"As a result of this experience and similar experiences in many other Fusetron installations in our mills, our general store keeper now carries practically all sizes of Fusetrons in general store room stocks and our plant is well along the way to completely standardizing on Fusetrons."

(Company name on request)

What IS *a* Fusetron?

The Fusetron is Bussmann's dual element fuse — a fuse with tremendous time-lag and much less electrical resistance.

Fusetrons have the same degree of Underwriters' Laboratory approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses, Fusetrons fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

BUSS

Get Double Protection for Large Motors with FUSETRONS

Of course, large motors are protected by thermal cutouts or overload relays. These devices save many motors, BUT experience shows that they sometimes fail to operate and a motor burns out.

By replacing ordinary fuses used for short-circuit protection with FUSETRONS of *motor-running* protection size, you can — on normal installations — get the same short-circuit protection PLUS DOUBLE PROTECTION against motor burnout from any electrical overload including single phasing.

A FUSETRON will act independently to protect the motor. There is nothing to stick, nothing to go wrong. They cannot be reset. Neither can corrosion nor dirt lengthen their blowing time. When the solder in the thermal cutout melts, the circuit is open — the motor is saved.

How FUSETRONS Protect Against Damage From Single Phasing

When single phasing occurs, the current flowing through Fusetrons in the remaining phase increases approximately 100%. This overload on Fusetrons of motor-running protection size opens them and stops the flow of current.

Never before has there been such a dependable way to protect motors against burnout due to single phasing.

Why FUSETRONS Can Give Protection to Any Motor — From 0 to 400 Ampere Size

Fusetrons have a tremendous time-lag. Thus, on normal installations, they can be used in a size near to the actual running current of the motor — without opening on motor-starting current or other harmless overloads.

When so used, Fusetrons protect motors on normal installations from ANY harmless excess of current — caused by such things as being stalled, lack of oil, worn bearings, tight belt, overloading, wrong voltage or single phasing or anything that causes the motor to draw a dangerously excessive current.

Fusetrons Give Many Kinds of Protection Heretofore Not Available

* Entirely wipe out needless blows caused by motor starting currents or other harmless overloads.
* Give Thermal Protection to Panelboards and Switches.
* Operate cooler because of lesser resistance, thus prevent needless blows caused by heating in panels and switches.
* Permit use of larger motor or adding more motors on circuit WITHOUT installing larger switch or panel.
* On new installations, PROPER size switches and panels can be used instead of OVERSIZE.
* Protect small motors against burnout simply and inexpensively.
* Give DOUBLE protection to large motors.
* Provide simplest way to stop burnouts from single phasing.
* Protect coils, transformers and solenoids against burnout.

Send the Coupon Now

GET ALL THE FACTS —

Find out how it will pay you to install Buss Fusetrons throughout your electrical system.

One lost motor — or one needless shut-down — or one destroyed panel, may cost you far more than replacing every fuse with a FUSETRON.

Don't risk such losses — protect yourself by changing over your entire electrical system to FUSETRONS.

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)
Please send me complete facts about BUSS Fusetrons.

Name_____
Title_____
Company_____
Address_____
City_____ State_____
748

Fusetrons

Sold Through Wholesalers

Specify Republi

A Republic combustion control system operates the three boilers in this new power plant which supplies all the steam and power for a large university. During the first year of operation this new plant provided heat for
percent more building space, generated 114.3 per
more electric power but consumed 9.86 percent less

REPUBLIC
INSTRUMENTS
AND CONTROLS

Combustion Control

TO INCREASE TODAY'S STEAM PRODUCTION

TO DECREASE TOMORROW'S STEAM COST

The installation of Republic automatic controls on your boiler (or boilers) will enable you to:—

SAVE FUEL by automatically maintaining highest combustion efficiency.

INCREASE STEAM OUTPUT by operating the boilers at test efficiency 24 hr. a day, 7 days a week.

CONSERVE MANPOWER by automatically performing the many routine repetitive adjustments.

REDUCE OUTAGES by maintaining uniform operating conditions and thereby prevent the chain-of-event type of trouble that frequently developes as a result of incorrect boiler operation.

An automatic combustion control system, as designed and built by Republic, will help you meet today's need for more steam and tomorrow's need for lower steam costs.

The Republic combustion control is a unified system controlling simultaneously, in measured quantities and in correct proportions, the fuel and air input to the boiler. It increases or decreases the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency. It not only checks operation but automatically makes necessary corrections of individual factors before faulty operation has a chance to develop.

The difference between such a control and an assembly of uncoordinated regulating devices is comparatively small in equipment but great in principle. Merely to provide automatic operation of a number of individual device is not enough.

CHECK THESE FEATURES

Built into the Republic combustion control systems are many features that enable it to fulfill all the conditions of theoretically perfect combustion control and still meet all the demands of everyday operation.

Check the following features against your list of "musts" for a perfect combustion control system.

CENTRALIZED CONTROL: The operation and control of the boiler or boilers is centralized at the master controller.

FUEL-AIR RATIO INDICATOR: The master controller is provided with mercury manometers which indicate the measured fuel and air inputs to the boiler and the fuel-air ratio.

FUEL-AIR RATIO ADJUSTMENT: A handwheel on the front of the master control panel provides a convenient means for adjusting the fuel-air ratio.

ALL BOILER RATINGS: Maintains proper fuel-air ratio over the entire range of boiler ratings.

CONSTANT STEAM PRESSURE: Maintains the plant steam pressure within narrow limits of variation by proportioning the fuel and air inputs to the load.

LOAD DISTRIBUTION: Provides a means of distributing the load among the boilers as desired.

MANUAL CONTROL: Boiler ratings can be controlled manually by a handwheel located on the front of the panel.

Find out about Republic control systems. One of our engineers will be glad to consult with you at any time. Write us today.

Republic Flow Meters Co.

2240 Diversey Parkwav • Chicago 47, Illinois

FREE AIR? ...NOT

Fig. 1840
Air Nozzle
Available with
various tips

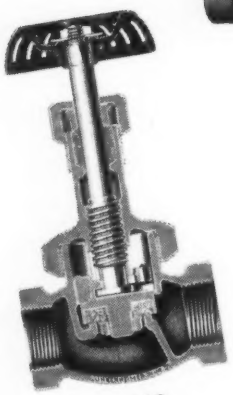


Fig. 123
N-M-D Valve
Non-Metallic Disc

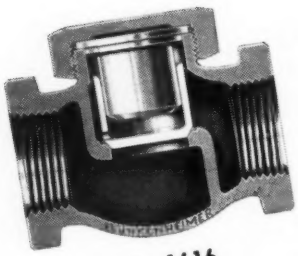


Fig. 1616
Air Compressor
Check Valve . . .
Hollow Stainless
Steel Disc

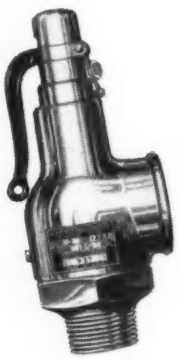


Fig. 1227
Pop Safety Valve
for Air

Stop those air leaks now. Your Lunkenheimer Distributor has a stock of Cocks, Globe and Angle Valves, Nozzles, Safety Valves, Check Valves, Tips, Nipples and other fittings for your needs. *Write for Circular No. 587 and enlarged copy of air leak chart, suitable for posting.*

LUNKENHEIMER VALVES

ON YOUR LIFE!!

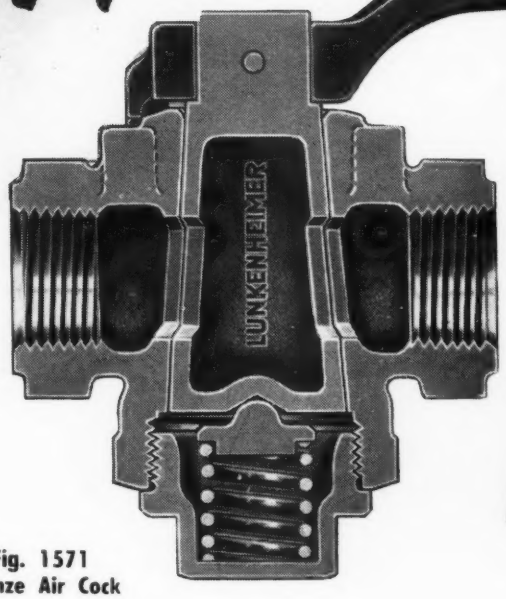


Fig. 1571
Bronze Air Cock

COMPRESSED AIR IS A VALUABLE TOOL...
but costly if wasted!
SAVE IT WITH LUNKENHEIMER AIR DEVICES

That h-i-s-s-s-s-s you may hear around your air lines means there's a villain loose in your plant. Costly compressed air is escaping, costing you money by the minute. But, you say . . . "it's only a pinhole, can't amount to much." Look at the chart below.

A SMALL LEAK MAY COST YOU AS MUCH AS $5.82 A MONTH

AREA OF LEAK	AIR	
Diameter Inches	Number of cubic feet per month at 75 lb. pressure	Total cost of waste per month 11c per 1000 cubic feet
1/4"	3,366,990	$ 370.37
1/8"	824,570	$ 90.70
1/16"	213,000	$ 23.43
1/32"	52,910	$ 5.82

Check your plant . . . compressed air leaks mean that good dollars are "gone with the wind." Replace leaky or defective air devices with LUNKENHEIMER Air Cocks, Valves, Nozzles. Designed for air line service, LUNKENHEIMER Air Devices seat tight and stay tight, requiring minimum maintenance for long, efficient service life.

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI 14, OHIO. U. S. A.

NEW YORK 13 CHICAGO 6
BOSTON 10 PHILADELPHIA 34

EXPORT DEPT. 318-322 HUDSON ST., NEW YORK 13, N. Y.

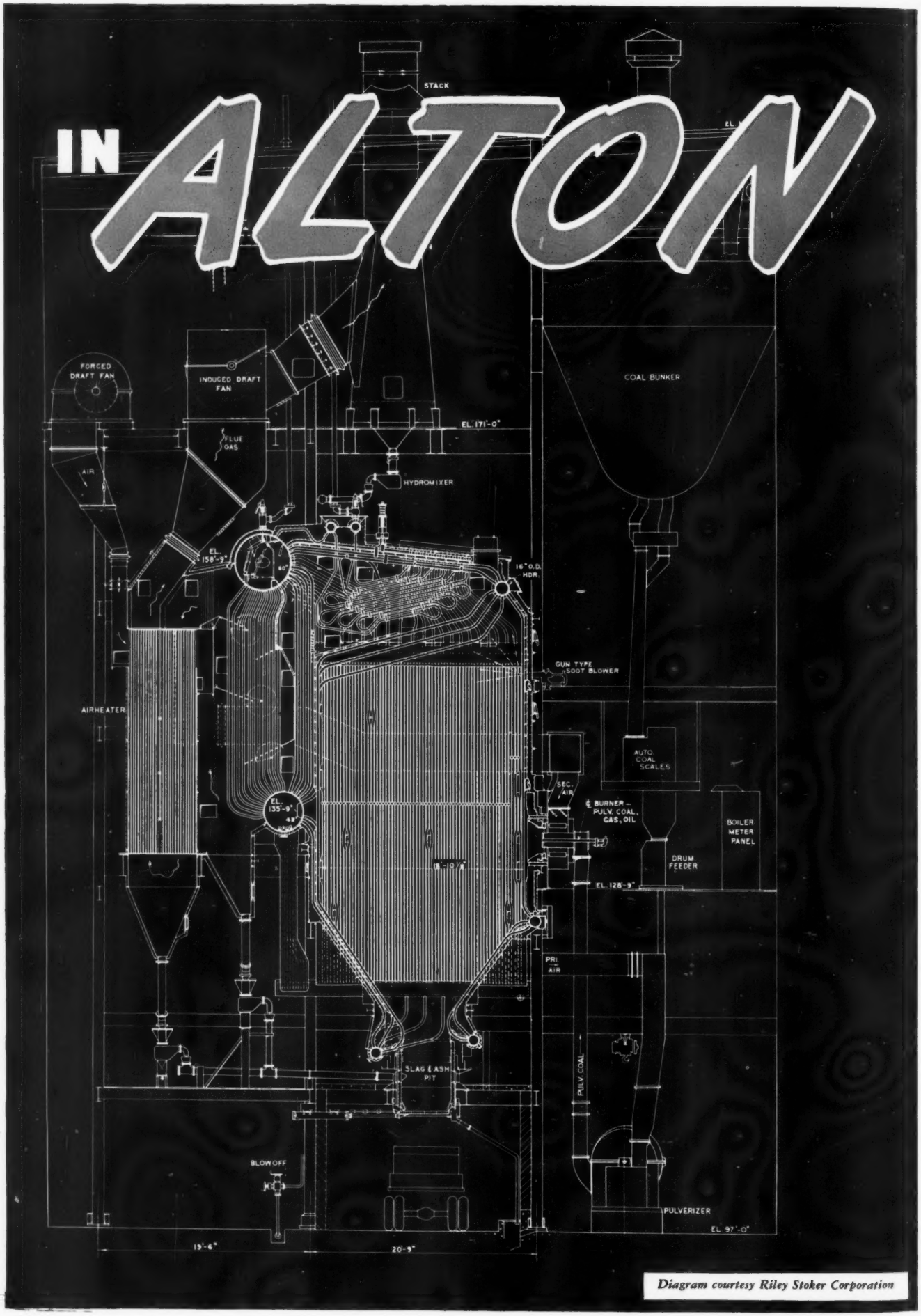


Diagram courtesy Riley Stoker Corporation

it's ELECTRUNITE

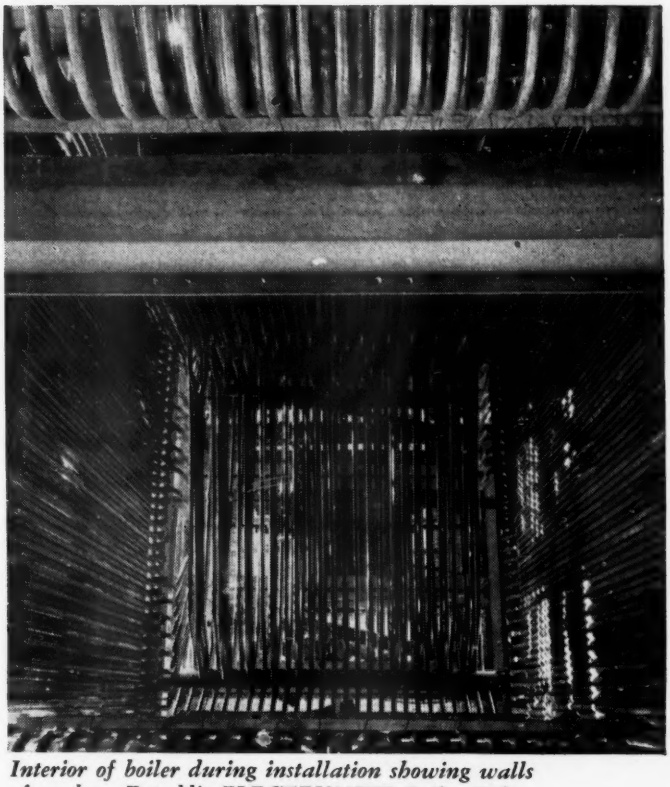
. . . USED IN NEW STEAM GENERATING UNIT AT ALTON BOXBOARD COMPANY

With a rated capacity of 100,000 pounds of steam per hour, this modern boiler plays an important part in pulp processing operations at the Alton Boxboard Company in Alton, Ill. Unfailing dependability is a "must" requirement for uninterrupted operation of the production line. Thus, it's easy to understand why Mr. R. F. Hollis, General Superintendent, was particular about the tubes which were installed in this unit.

In Mr. Hollis' own words: "We've been completely satisfied with ELECTRUNITE Boiler Tubes—both during their installation in 1944, and in subsequent tests and operation of the finished job. In fact, they're the smoothest rolling tubes I've ever seen."

Such statements are not unusual with men who have used Republic ELECTRUNITE Boiler Tubes. In countless installations these modern tubes have demonstrated continually the many cost-cutting advantages resulting from the *superior* electric resistance welding method by which they are made.

For new boiler installations or retubing of existing units, it will pay you to investigate these advantages of easy-to-install, long-lasting ELECTRUNITE Boiler Tubes. Informative literature and technical data is available upon request. Write *today* to:

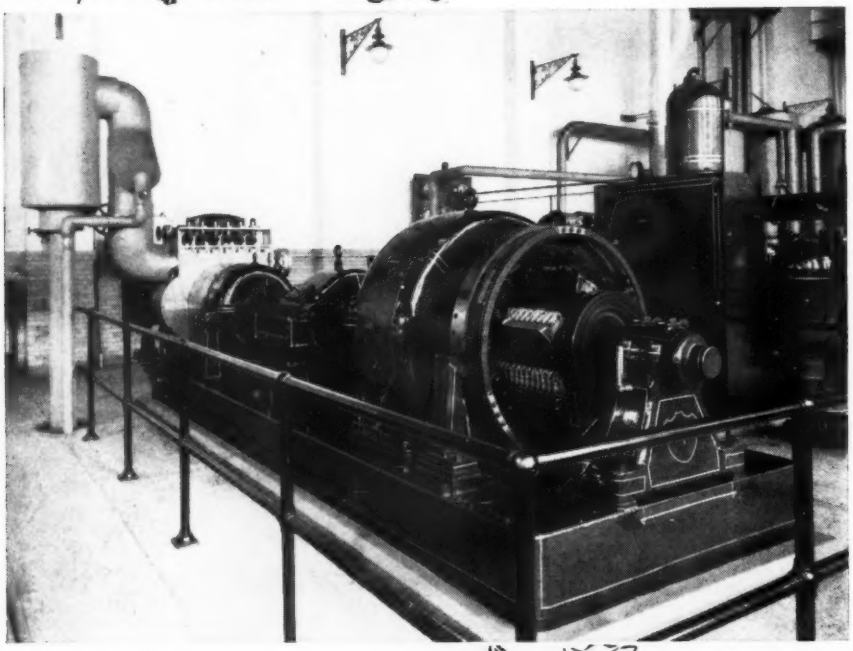


Interior of boiler during installation showing walls of modern Republic ELECTRUNITE Boiler Tubes.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York

Republic REPUBLIC STEEL
ELECTRUNITE
Reg. U. S. Pat. Off.
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

This veteran has been PAYING a bonus for years!



The Worthington installation at the Oak Forest, Illinois, Infirmary. The 600kw geared direct-current turbine-generator is non-condensing, operating on steam at 150 lb initial pressure, 0 deg F superheat, and exhausting to 3 lb back pressure.

A Worthington Turbine-Generating Unit That Soon Earned Its Purchase Cost

Take a look at a gilt-edged investment in power! The Worthington Turbine-generating unit shown here was installed in the Oak Forest Infirmary, Cook County, Illinois, almost ten years ago. Besides generating electric power, the turbine supplies exhaust steam for heating water, cooking, baking and to heat various buildings. No live steam direct from the boilers is used for heating because, like the turbine-generating unit, most of the auxiliaries such as pumps and fans are steam driven.

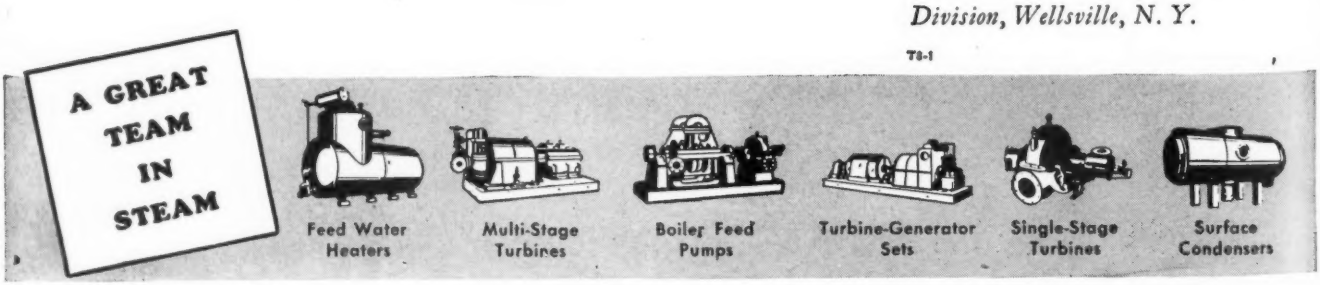
Since installation this Worthington unit has operated continuously without attention — except for routine inspection.

The Infirmary's engineers estimate that by running their own plant — instead of purchasing power outside, and generating steam only for heating — the resultant savings have paid for the Worthington unit several times over.

When YOU Buy Turbine Power ... make sure you're getting the lasting economy and efficiency that proves *there's more worth in Worthington.* For further information, including expert technical advice on power problems, write to *Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y.*

T8-1

WORTHINGTON



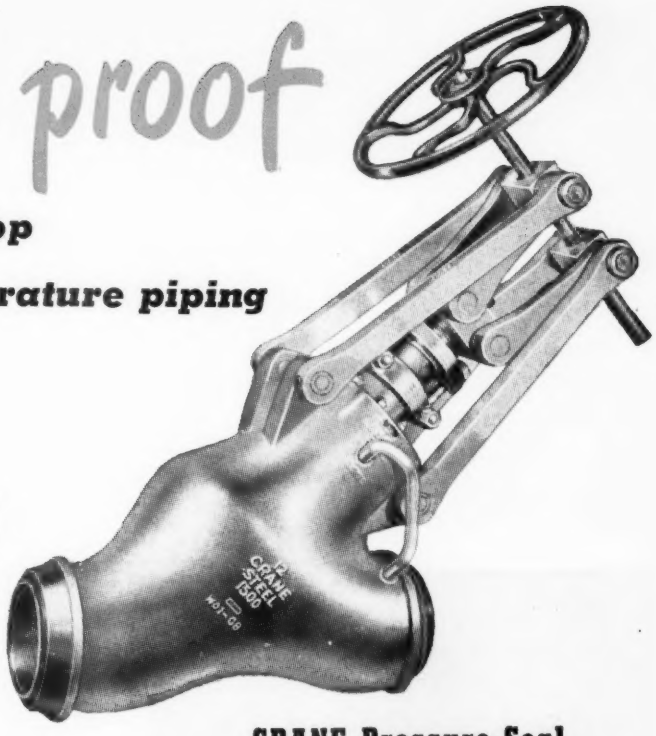
Here's real proof

of low pressure drop

in high-pressure ... high-temperature piping

the valve

12-in., 1500-Pound Crane Pressure-Seal Bonnet Globe Stop-Check ... installed in main steam lines of central station operating at 900 psi, 900 Deg. F.



the test

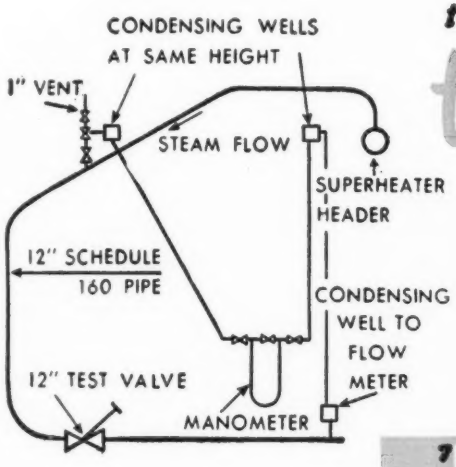
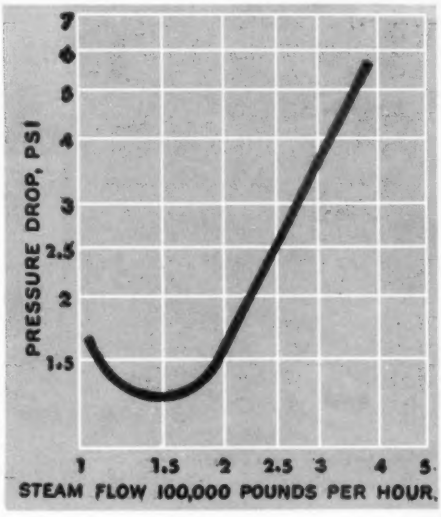


Diagram of steam piping from boiler, and manometer piping used for test. Rate of steam flow secured from flow meter in boiler room.

the result

Performance curve showing considerably lower pressure drop than demonstrated by other valves in the same service in the past.



CRANE Pressure-Seal Bonnet Design

"perfect for power services"

GATES · GLOBES · ANGLES · STOP-CHECKS

Performance records like this—setting entirely new standards of efficiency for flow characteristics and control — are common experience with the many *repeat* users of Crane Pressure-Seal Bonnet Valves from coast to coast.

Here, without question, is the biggest valve value today—assuring more and easier power flow through valves—completely eliminating bonnet joint leakage and maintenance — with unbelievable space and weight savings over conventional valve design. Gate valves, depending on size, are up to 60% lighter.

WRITE ... WIRE ... OR PHONE your nearest local Crane Branch for performance data, prices, and delivery.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.

Branches and Wholesalers Serving All Industrial Areas

8-in. 1500-Pound Pressure-Seal Bonnet Gate Valve

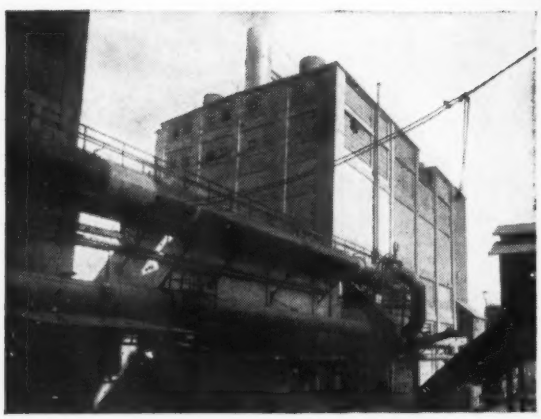
EVERYTHING FROM ...

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

CRANE

FOR EVERY PIPING SYSTEM

Chessboard and Jigsaw Methods



In 1940 Dravo constructed a power plant addition, housed in the two left bays, to supplement the boiler capacity of the original plant.

View of new Weirton power plant, completed by Dravo in 1947. Note how railroad tracks limited construction space.

Expedite Power Plant Construction

Weirton Steel Company power plant

completed by Dravo without interruption of work schedules

Here, at Weirton Steel Company, were all the elements to challenge Dravo Power Plant Specialists:

(a) power plant expansion plans with limitations on construction space

(b) equipment installations complicated by rail traffic, water supply lines, coal- and ash-handling systems

(c) a twenty-four-hour mill operation which could not be interrupted

But chessboard and jigsaw methods are no hindrance to Dravo Power Plant Specialists. Dravo engineers are accustomed to applying unique construction techniques—are trained by industrial experience to integrate work schedules with mill operations.

Without any interruption of steel production, without any changes in railroad operation, main plant water lines were moved to temporary locations then into a permanent underground tunnel after foundations were prepared. Coal-handling and ash-handling installations were routed from place to place, always functioning to keep steel moving. Each step in this elaborate operation was so carefully coordinated that boiler installations were completed in record time in spite of frequent construction delays.

When it was finally erected, the building housed these major equipment items neatly fitted into the irregular shaped, vertical power plant:

(a) one 325,000 lbs. per hour boiler, operating at 800 psi. and 800° at superheater outlet

(b) combustion control to integrate fuel feed with steam demand

(c) forced and induced draft fans

(d) boiler feed and booster pumps

(e) heat exchanger

(f) coal-handling and ash-handling equipment

Here again Dravo experience in the engineering construction of boiler and power plants, and in major equipment installations, proved its worth just as it had in previous Dravo installations at Weirton Steel Company. This Dravo experience can save you time and space and prevent work interruptions—relieve your engineering and supervisory staffs of many burdens when you construct, expand or modernize your boiler and power facilities. It's never too early to call in Dravo Power Plant Specialists.

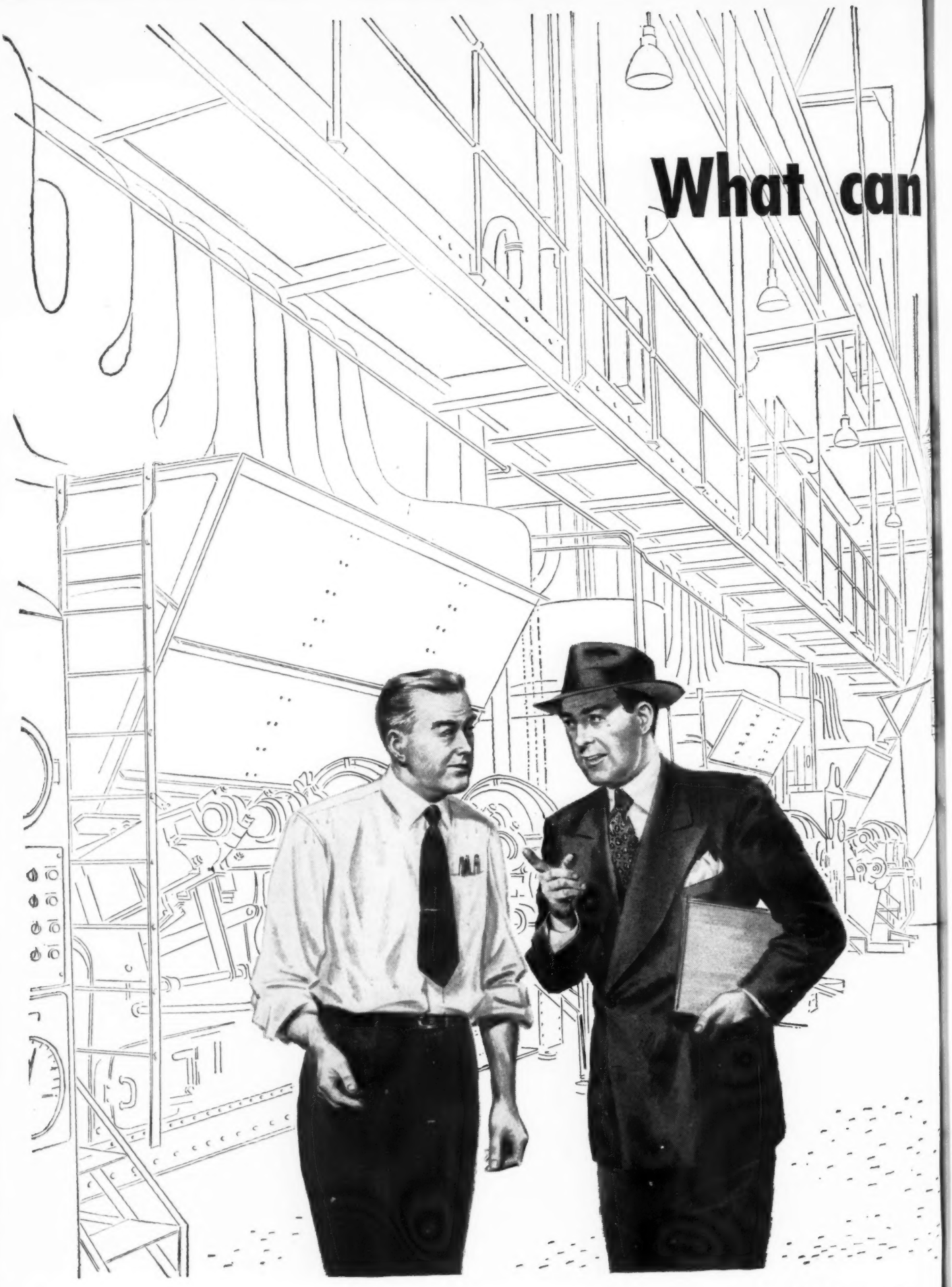
DRAVO CORPORATION

PITTSBURGH • PHILADELPHIA • CLEVELAND • NEW YORK • DETROIT

Power and Boiler Plants • Pumping Stations • Power Plant and Contractors' Equipment • Direct-Fired Heaters
Industrial Heating and Ventilating • Bridge Substructures • Docks • Pump Houses and Intakes • Mill Foundations
Locks and Dams • Shafts, Slopes and Tunnels • Towboats and Barges • Coal and Ore Bridges • Cranes and
Derrick Boats • Crane Cab Coolers • Open Steel Flooring • Concrete Aggregates • Inland River Transportation

DRAVO

What can



an "outsider" know about your boiler problems?

You naturally feel that you know more about your boilers than anyone else—but nevertheless Hall representatives have certain advantages that you can use to *your* advantage.

In the first place, Hall engineers have *specialized* training. They have had to make an intensive study of water and the many impurities that may be found in it; just what happens in a boiler when various types of water are used under different conditions; how to treat boiler water to prevent troubles; and, when troubles do arise, how to recognize them and trace them to their source.

They have *broad experience.* Each Hall engineer is familiar with hundreds of boilers, is constantly visiting dozens of plants and knows these plants intimately. A troublesome condition may be new to you — but the chances are 100 to 1 that your Hall engineer has already met the same situation elsewhere and knows what to do about it.

Finally, Hall engineers are not working alone. They have the cooperation of the whole Hall organization—which means the accumulated experience of more than 25 years of boiler water conditioning, *plus* laboratory facilities and personnel which are unsurpassed in this field, *plus* a program of continuing research which keeps this organization ready to meet every new requirement.

Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

HAGAN HALL BUROMIN CALGON

HALL LABORATORIES, INC.

(A Subsidiary of Hagan Corporation)

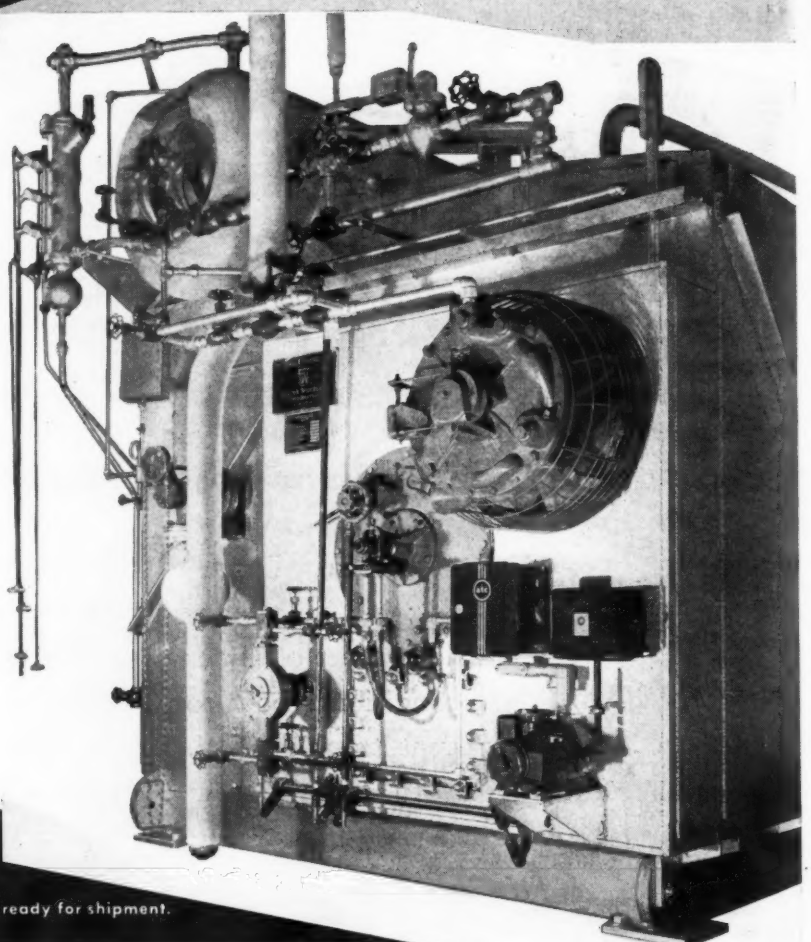
CONSULTANTS ON
INDUSTRIAL WATER TREATMENT
HALL SYSTEM OF BOILER WATER CONDITIONING
INDUSTRIAL WASTE RECOVERY AND DISPOSAL

The NEW Foster Wheeler Package Steam Generator is...

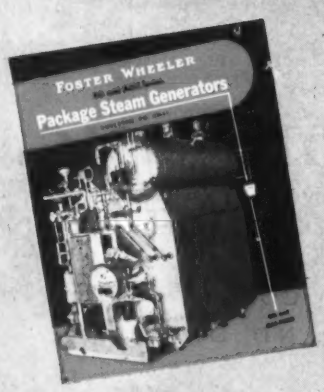
FACTORY ASSEMBLED --READY TO INSTALL

The name "package" applied to these steam generators means that all components, including burners, fans, soot blowers, feedwater regulators, combustion controls, valves, refractory, insulation and other accessories, are assembled in one package at the factory. The local labor necessary for installing this package is limited to service connections.

FOSTER WHEELER CORPORATION
165 Broadway, New York 6, N.Y.

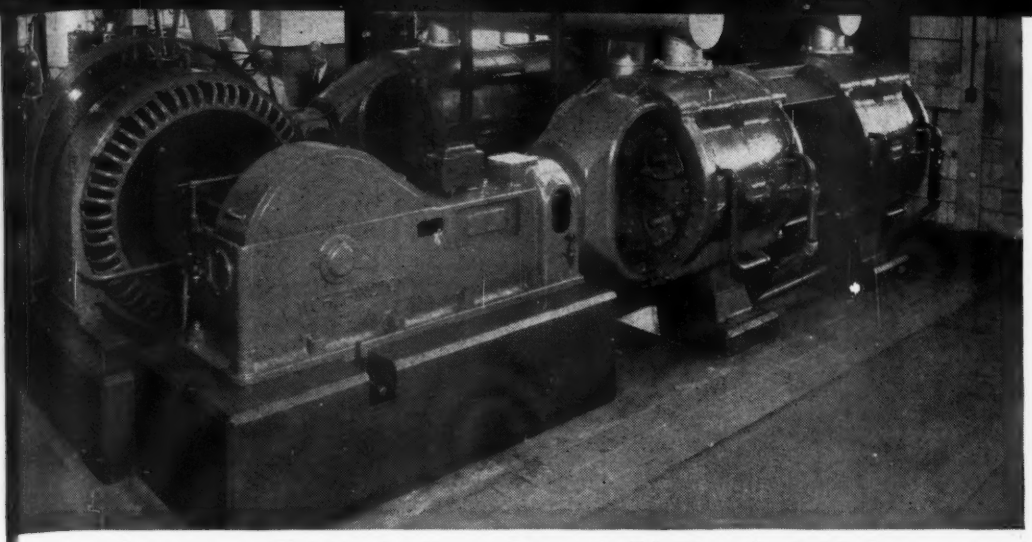


This AG 21-0 package steam generator 21,000 lb. per hour steam capacity, as shown here, is ready for shipment.



FOR
FURTHER INFORMATION
WRITE FOR
BULLETIN PG 47-17

FOSTER WHEELER



Worthington 32 x 16 Twin Tandem Vacuum Pump at Buffalo Electrochemical Co. Inc.

Triples the Run

Hydrogen Peroxide is manufactured by Buffalo Electrochemical Co. Inc.

Originally, vacuum pumps of the slide-valve type were used, and these were imported from Switzerland because no other pumps were available in this country that could meet specifications at a reasonable price. During the war—at the very time production requirements expanded—the Swiss pumps were unavailable. So BECCO engineers made a thorough study of all domestic pumps to determine which make would handle the highly oxidizing and corrosive gases with the least possibility of failure.

The result of the investigation was the selection of a Worthington 32 x 16 twin-tandem, two-stage, four-cylinder dry vacuum pump. The reason for the selection was chiefly the simplicity of the Worthington Feather* Valve, the lightest, tightest, quietest ever made.

Although the installation was considered experimental, inspection following the initial 10-week run showed that its performance exceeded that of the original Swiss pumps. Since then, the Worthington pump has operated on regular 10-week periods between inspections and cleaning, as compared with previous 3-week periods.

The pump is rated at 5571 cfm displacement—approximately 20% larger than other existing pumps—and is suitable for handling vacuum down to 0.25 in. Hg absolute. The guaranteed vacuum on blank suction of 0.25 in. has been exceeded.

Reg. U.S. Pat. Off.

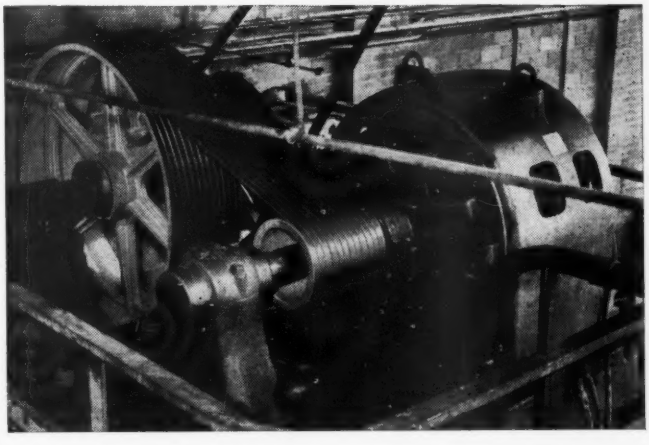
All Quiet on the Clay Machine

A chain drive to a 150 hp clay machine in an Akron, Ohio, plant had been annoying workers with its noise and keeping maintenance men busy with repairs. Each case of break-down involved work interruption for at least a dozen men.

To replace the chain drive, a Worthington Multi-V-Drive was installed—14.5 in. QD driver sheave and 58.0 in. QD driven sheave, with 12 Worthington-Goodyear Steel Cable V-Belts, "D" Section.

This unit is driving a line shaft transmitting 150 hp from flat belting to two pug mills which operate one at a time. The drive is designed to meet this change-over in operation. The drive motor is rated at 300 hp.

The job was installed and operating seven and one-half hours after arrival at the plant.



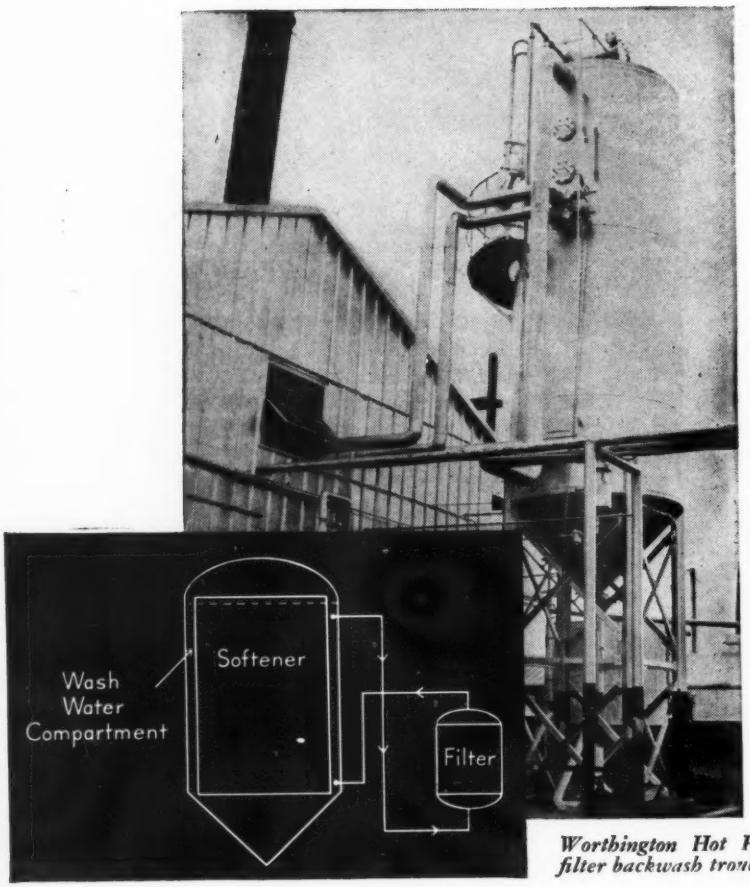
Worthington—Goodyear Multi-V-Drive on clay machine (pug Mill) in Akron plant.

NEWS

FROM THE POWER FRONT

AS REPORTED BY THE DEVELOPMENT ENGINEERS FIELD SERVICE REPRESENTATIVES AND CUSTOMERS OF WORTHINGTON

The Only Uniformly Continuous Hot Process Water Softener



Worthington Hot Process Deaerating Softener design eliminates filter backwash troubles.

Continuously uniform water treating results can be obtained only if treating process remains undisturbed during recirculation of filter backwash water.

Worthington's exclusive design completely divorces the filter backwashing operation from the treating process, thereby permitting continuously uniform treatment and preventing filter deterioration.

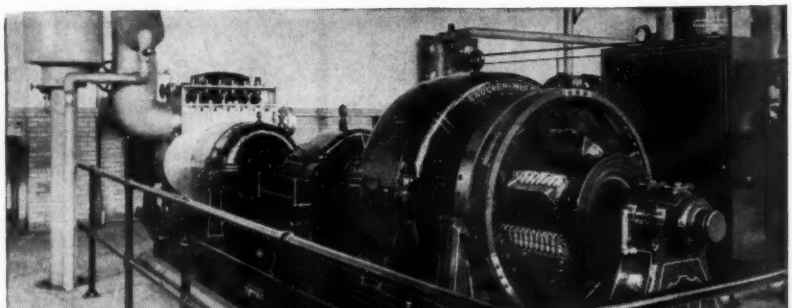
A wash water storage and settling compartment (see diagram) provides clear, hot, deposit-free water for backwashing purposes, thereby eliminating filter difficulties, increasing the period between backwashing operations and decreasing the time of the backwashing operation. The filter is washed clean with clean water without disturbing the softening process.

10 Years in a Hospital and Never a Patient

Ten years ago, the Oak Forest Infirmary in Oak Forest, Illinois, installed a Worthington 600 kw geared direct-current turbine-generating unit.

Over the ten years, the unit has operated continuously and without attention in the way of service except for an inspection every four or five years.

The machine is a non-condensing unit operating on steam at 150 lb initial pressure, 0 deg F superheat, and exhausting to 3 lb back pressure. The exhaust is used for heating water, cooling, baking and to heat various buildings in the institution. No live steam direct from the boilers is used for heating since, in addition to the turbine-generating unit, most of the auxiliaries such as pumps and fans are steam-driven.



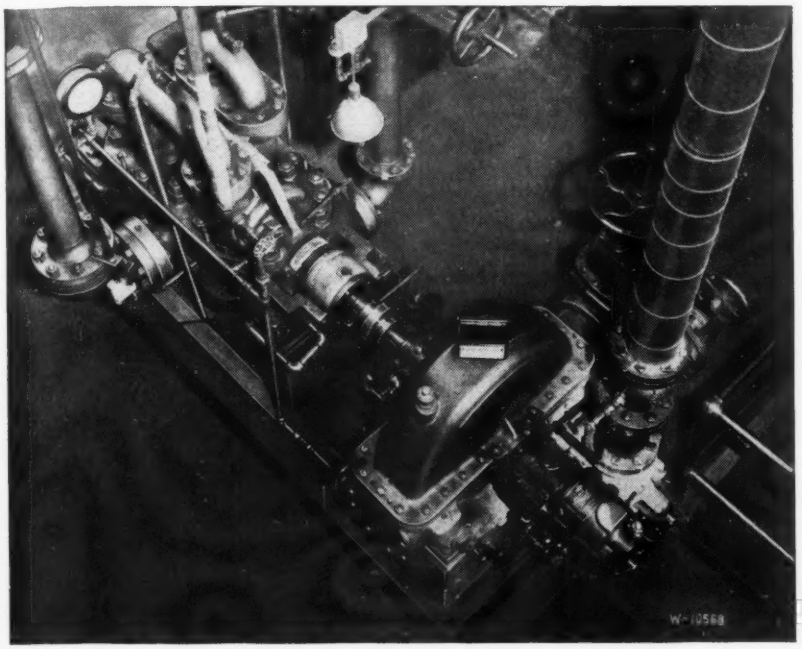
Worthington Turbine-Generator—Oak Forest Infirmary, Oak Forest, Ill.

It is estimated that the savings made by running their own plant, over the cost of purchased power and generating steam for heating only, have been substantial, paying for the Worthington unit a number of times over.

Worthington Pump and Machinery Corporation
Harrison, N. J.

NEWS

Pumping for Pipe Testing



Worthington 4-UX-1 Pump and Worthington T2RA Turbine . . . supplying high pressure water, A. M. Byers Company, Pittsburgh, Penna.

A. M. Byers Company, as you probably know, manufactures wrought iron pipe for many purposes—particularly for the fast-becoming-popular radiant type of heating.

All its pipe is carefully tested in the plant, and for this purpose it uses a weighted accumulator system. To supply the high pressure water, Byers selected a Worthington pump and Worthington turbine. Choice of the Worthington equipment was based primarily on its compactness, economy in steam consumption, and the speed with which it gets into operation.

The pump is a 4-UX-1, designed for capacities between 350 gpm and 500 gpm, producing 800 lb TDH with 50 ft or more of suction pressure. It runs at 3600 rpm, and the minimum BHP required at the maximum condition is 334.

The turbine is rated 350 hp at 3600 rpm, and operates on 156 lb steam with 50F superheat and 2 lb gauge back pressure. It is equipped with a hand speed changer.

Sewage Gas Engine Returns $199,000

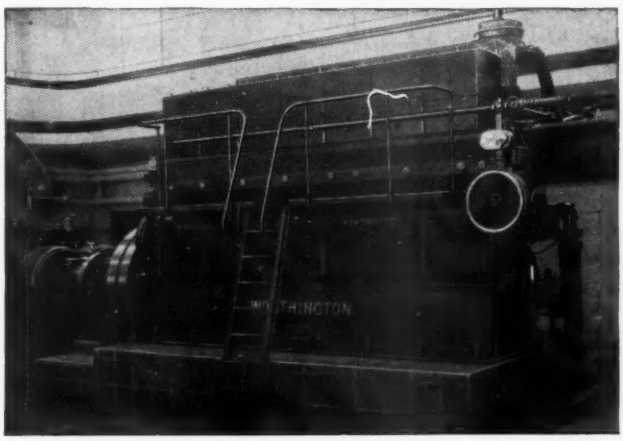
The annual report of the Fort Wayne (Indiana) sewage treatment plant reveals a 1946 saving of $38,000 by the 465 hp Worthington gas engine installation. This brings the total six-year saving to $199,000.

This plant, considered one of the outstanding municipal developments in the country and a focal point for inspection tours by engineers from other communities, was completed in 1940. Fort Wayne had been mandated by the Indiana State Board of Health to cease pollution of the Maumee River, and now the treated sewage is so free of offensive material that the river is capable of sustaining fish life.

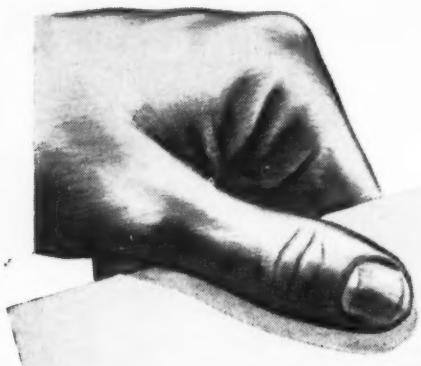
Total sewage treated in 1946 amounted to 6,648,960,000 gallons—an average of 18.73 million a day. From this 7,000 tons of sludge was removed, and into it 5,345,890,000 cubic feet of air was pumped.

The Worthington gas engine was originally purchased at a cost of $30,000. The estimated saving is based on what it would have cost otherwise for additional electric power.

The engine contributes to heating the sludge digesters. The sludge is pumped in liquid form into four covered digesters where it is decomposed by bacteriological action, producing methane gas. Heat from the circulating water in the engine is used to raise the temperature of the sludge to the desired point for proper bacteriological digestion. In 1946, nine billion BTU's of heat went from the engine to the digesters — equivalent to 650 tons of coal.



Worthington Sewage Gas Engine—Fort Wayne, Indiana, Sewage Treatment Plant.



HERE'S PROOF

of Æ Perfect Spread Stoker's PERFORMANCE! DEPENDABILITY! LOW-COST OPERATION!

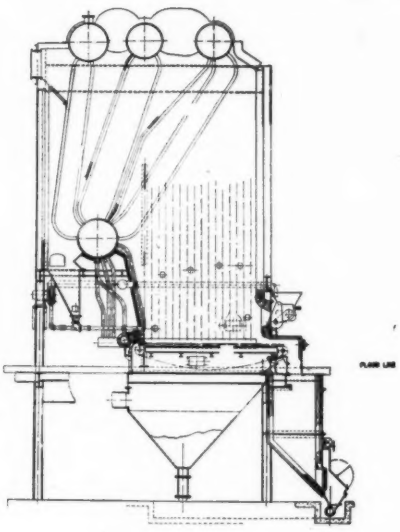
Recognized for over 19 years as a highly efficient, economical stoker, the Perfect Spread Stoker is backed by American Engineering Company's 44 years of combustion engineering experience. Check the recent contracts listed below and write to us today for the names of other industrial and commercial plants which have purchased Æ Perfect Spread Stokers . . . to get more steam at lower cost.

SOME RECENT CONTRACTS FOR Æ PERFECT SPREAD STOKERS WITH CONTINUOUS ASH DISCHARGE

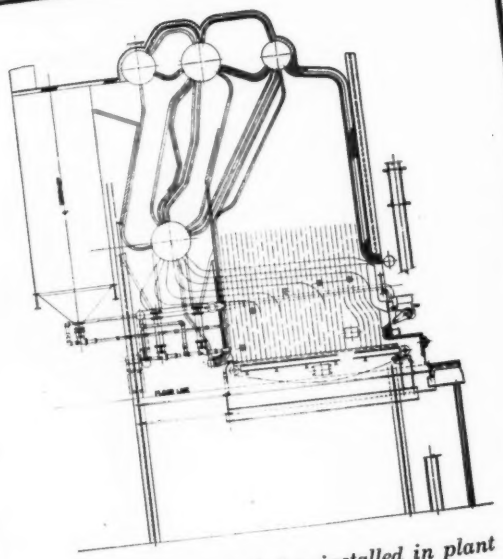
4 units	70,000 lb./hr. each—	*Flint, Michigan*
2 units	60,000 lb./hr. each—	*Saginaw, Michigan*
4 units	80,000 lb./hr. each—	*Cleveland, Ohio*
2 units	180,000 lb./hr. each—	*Pontiac, Michigan*
2 units	60,000 lb./hr. each—	*Kalamazoo, Michigan*
1 unit	60,000 lb./hr.	*—Oaks, Pennsylvania*
2 units	38,500 lb./hr. each—	*Marion, Ohio*
2 units	70,000 lb./hr. each—	*Long Island City, New York*
1 unit	30,000 lb./hr.	*—Indianapolis, Indiana*
1 unit	70,000 lb./hr. —	*Lock Haven, Pennsylvania*

YOU CAN HAVE

WITH AN



Æ Perfect Spread Stoker installed in Michigan plant of large automobile manufacturer. Four units 70,000 lb/hr. capacity. Installed under Wickes Boilers.



Æ Perfect Spread Stoker installed in plant of large manufacturing plant in Michigan • Two units 21'0" by 17'3" installed under B&W boilers. Capacity each 180,000 lb/hr.

A PRODUCT OF

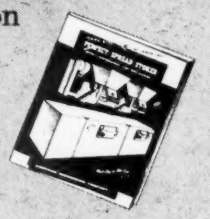
MORE STEAM AT LOWER COST—AUTOMATICALLY

Æ PERFECT SPREAD STOKER

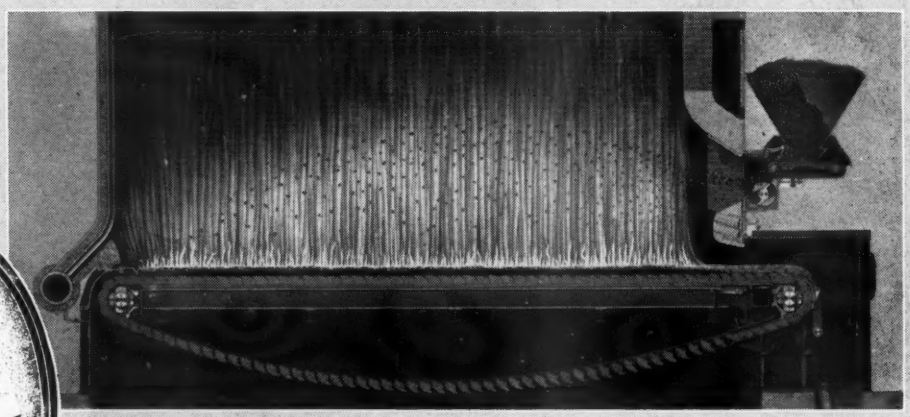
(CONTINUOUS ASH DISCHARGE)

Even using the lowest grades of solid fuels you can get more steam . . . at lower cost, with the new, improved, streamlined Æ Perfect Spread Stoker. It operates perfectly feeding wet, dry, or partially frozen coal or solid fuel . . . without clogging . . . an exclusive Æ Perfect Spread feature. Fuel is spread evenly over the grate and a perfect bed maintained by the unique Æ fuel distributing overthrow rotor. Ashes are removed completely automatically by the traveling grate which handles high or low ash fuels with equal ease.

If you want real freedom from fuel worries and maintenance problems, and if you want more steam at lower cost *now;* it will pay you to send for the Æ Perfect Stoker Bulletin. Leading power plants throughout the nation are installing Æ Perfect Spread Stokers (some recent contracts are listed in this ad). Act now to save fuel, and end high cost steam production —write for more information today.



FREE—Send for this informative bulletin now.



The Æ Perfect Spread Stoker—for requirements from 40,000 to 200,000 lbs. of steam per hour and upwards.*

*Dumping grates for smaller capacities

Won't Clog on Wet Coal!

PERFECT SPREAD STOKER

WITH CONTINUOUS ASH DISCHARGE

Also Available with Stationary and Dumping Grates

AMERICAN ENGINEERING COMPANY

2400 ARAMINGO AVENUE • PHILADELPHIA 25, PENNA.

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OTHER Æ PRODUCTS

- Taylor Stokers
- Lo-Hed Electric Hoists and Car Puller
- Marine Deck Auxiliaries
- Hele-Shaw Fluid Power

BALANCE . . .

is highly essential in valves, too!

Without proper balance between the design and materials of a valve on the one hand and the requirements of a given service on the other, the operations of an industrial plant can be seriously impaired.

That's why the slogan at Powell has always been "the valve must exactly suit the service."

And the net result of more than a century of following this principle is that today the complete Powell Line of Valves for Power Plants—in Bronze, Iron, and Steel—includes many designs especially adapted to meet the specific requirements of this important branch of modern industry.

Fig. 19031 W. E.—Class 900-pound Cast Steel Flangeless Bonnet Globe Valve with welding ends. Spur gear operated. Stellite faced.

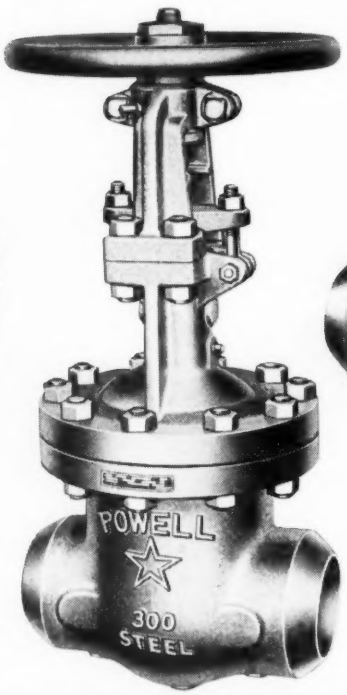


Fig. 3003 W. E.—Class 300-pound Cast Steel Gate Valve with welding ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

Fig. 11365 W. E.—Class 1500-pound Cast Steel Horizontal Lift Check Valve with piston guided disc, welding ends and the new flangeless cap.

POWELL

Fig. 11323 W. E.—Class 1500-pound Cast Steel Flangeless Bonnet Gate Valve with welding ends. Has top-mounted electric motor operator for quick, positive opening and closing by remote control.

Fig. 11313 W. E.—Class 1500-pound Cast Steel Flangeless Bonnet Gate Valve. Has venturied ports, welding ends and special by-pass. Bevel gear operated.

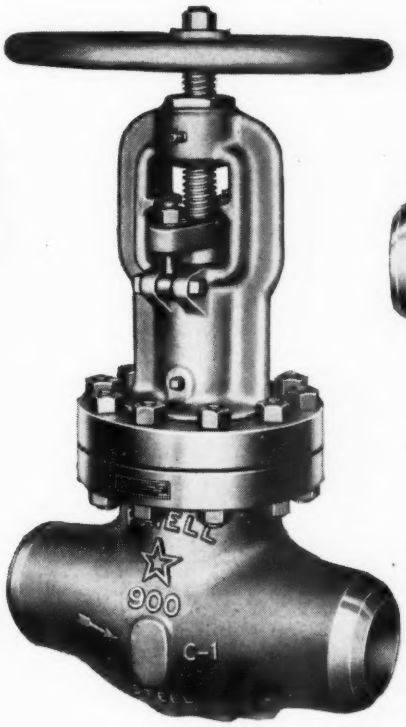


Fig. 9031 W. E.—Class 900-pound Cast Steel Globe Valve with welding ends, outside screw rising stem and bolted flanged yoke.

The Wm. Powell Company

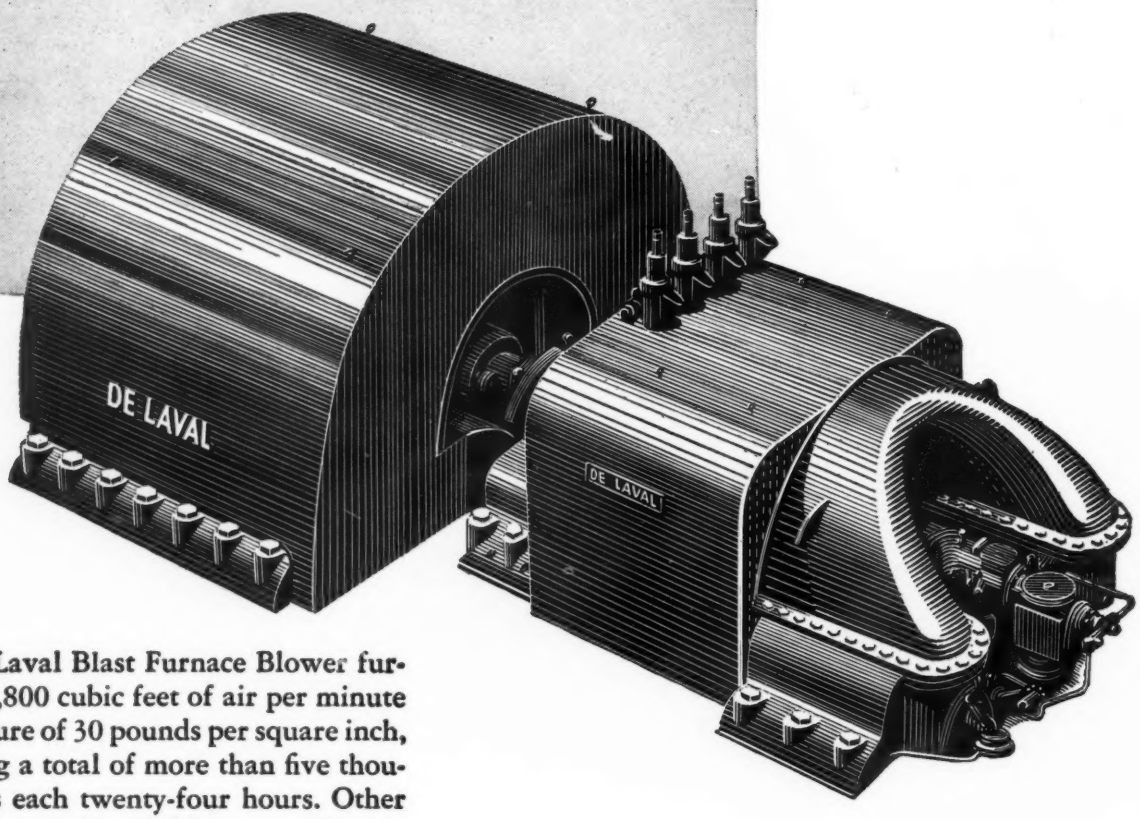
Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

VALVES

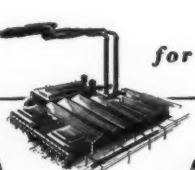
AIR

BY THE TON



This De Laval Blast Furnace Blower furnishes 97,800 cubic feet of air per minute at a pressure of 30 pounds per square inch, delivering a total of more than five thousand tons each twenty-four hours. Other De Laval centrifugal blowers and compressors are built for furnishing air and gases in large quantities at medium and moderately high pressures for chemical processing, oil refinery operations, sewage aeration, gas plants, coke ovens, aeronautical research and other industrial operations. For air by the ton consult De Laval.

DE LAVAL

De Laval  *for Industry*

C-4

DE LAVAL STEAM TURBINE COMPANY • TRENTON 2, N. J.

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

POWER

JULY 1948

VOLUME 92, NUMBER 7

A CROSS-INDEX OF SUBJECTS FOR THE MONTH

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PLANT OPERATING METHODS, MAINTENANCE AND SAFETY
STEAM GENERATION, FUELS, FIRING AND COMBUSTION
TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
DIESELS, GAS ENGINES AND ACCESSORIES
AIR CONDITIONING AND REFRIGERATION
ELECTRICAL EQUIPMENT, ELEVATORS
PIPING, VALVES AND SPECIALTIES
TRANSMISSION, LUBRICATION
STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

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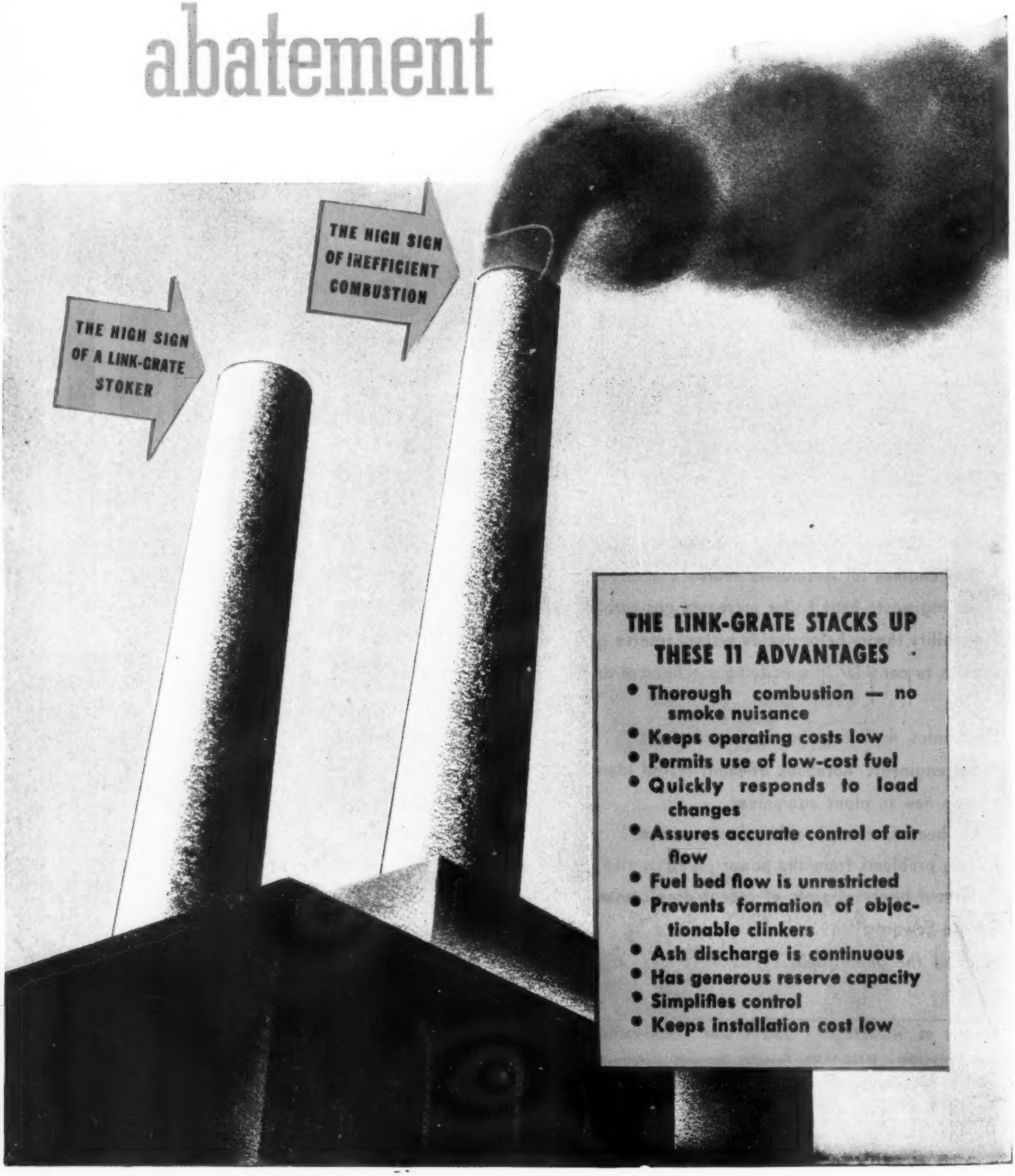
Three cheers for smoke abatement

1 ...from your fuel cost sheets



THE LINK-GRATE STACKS UP THESE 11 ADVANTAGES

- Thorough combustion — no smoke nuisance
- Keeps operating costs low
- Permits use of low-cost fuel
- Quickly responds to load changes
- Assures accurate control of air flow
- Fuel bed flow is unrestricted
- Prevents formation of objectionable clinkers
- Ash discharge is continuous
- Has generous reserve capacity
- Simplifies control
- Keeps installation cost low

2...from your Smoke Inspector

3...from your neighbors

Get all 3 with a Westinghouse Link-Grate Stoker

Smoke abatement means much more to you than to an outsider interested only in cleanliness. To you, it means more steam per pound of coal—more of your coal turned into heat, and less of it "up the flue" as soot.

You get these advantages with a Westinghouse Link-Grate Stoker because of its characteristic action. This action maintains a regular combustion rate by continuously processing the fuel bed to keep it porous. With this action, a positive motion at the rear of the stoker permits a uniform flow of coal over the underfeed section, to keep the burning lanes open.

In Link-Grate action, the grates first hinge upward to break open the fuel bed and let low-pressure air flow through the grates. The reverse movement of the grates crumbles and conveys the burning fuel.

Another effect of this Link-Grate action is the continuous ejection of the ash off the discharge plate—to do away with periodic dumping and to reduce labor costs. Clinkers are not a problem.

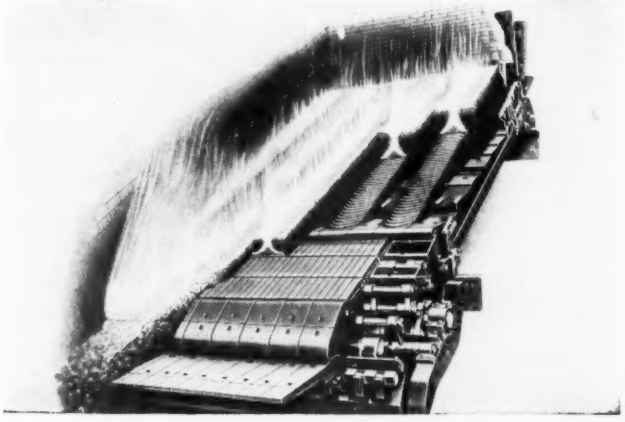
Since this action keeps the fuel bed always porous, the Link-Grate Stoker can meet suddenly increased steam demands quickly with full combustion efficiency.

Get the complete information about the Link-Grate before you make another investment in stokers. If possible, see one in operation. Your nearest Westinghouse office will be glad to arrange an appointment with a user. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-50470

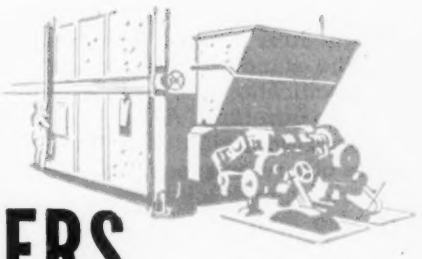
Show Link-Grate Movies in Your Own Office

A 15-minute sound moving picture has been produced to show in detail the operation of a Link-Grate Stoker. Whether you can visit an actual Link-Grate Stoker in operation or not, this interesting 16 mm. film will show you its action and explain its points of superiority while you sit at your desk. To borrow a print of this film for your own private showing, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.



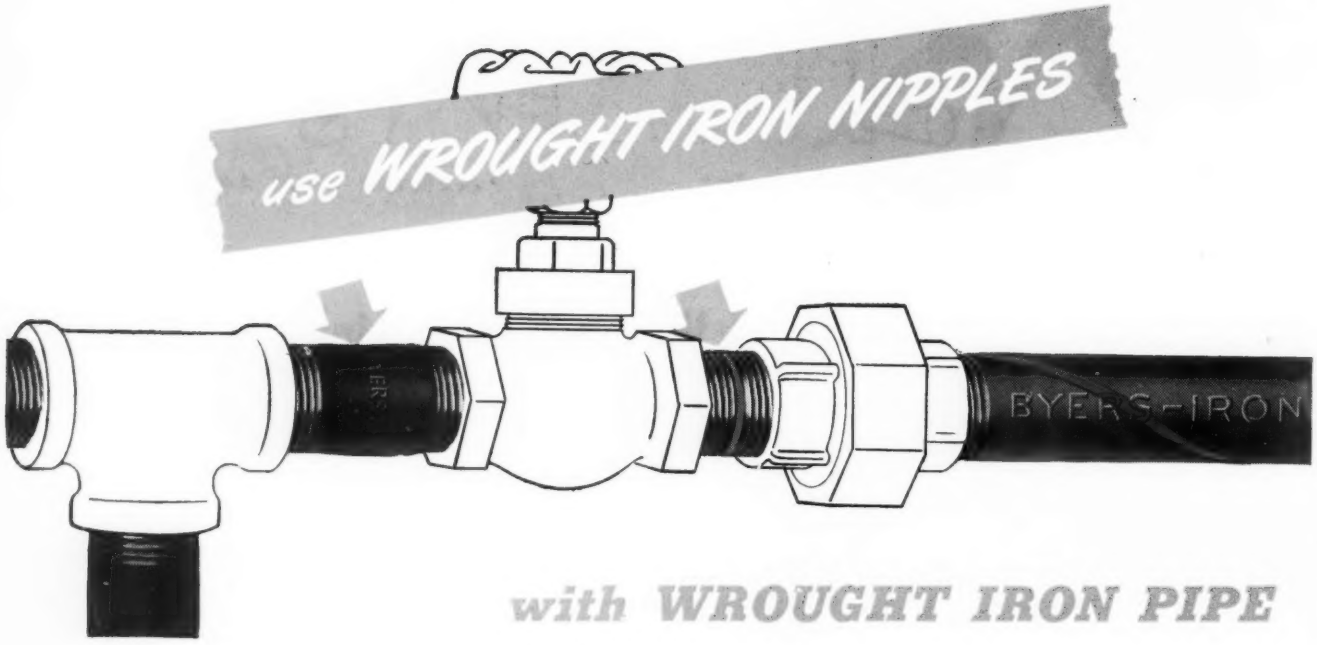
Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE



Link-Grate STOKERS

Avoid "Weak Links" in your piping systems—



When you specify wrought iron pipe to lick some corrosion problem, assure 100% protection by specifying that the pipe nipples also must be wrought iron. Neglect of this simple precaution will leave weak spots in your lines, and set the stage for maintenance headaches.

METHOD OF SPECIFICATION

Merely stating that the piping "system" is to be black or galvanized wrought iron is not enough; the use of wrought iron nipples should be specifically designated. This may be done by requiring that the wrought iron nipples shall be made of pipe conforming to the requirements of A.S.T.M. Specification A72-45, Federal Specification WW-P-441a, Navy Specification 44P11k, or any accredited proprietary specification.

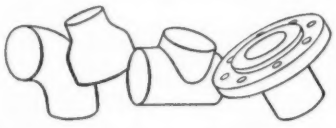
WIDE RANGE OF SIZES

Byers Wrought Iron nipples, both standard weight and extra strong, are available in a wide range of sizes and lengths, either black or galvanized. They are manufactured from new, tested, full-weight wrought iron pipe in accordance with the standards established in the specifications of leading technical organizations. All nipples are furnished with right-hand threads unless otherwise specified; nipples with right and left-hand threads are also available. Nipples are furnished "close" or to length as specified.

IDENTIFICATION

The word "Byers" and the weight —either "Std." or "X Stg." are machine stamped around the circumference of Byers Wrought Iron nipples. On close nipples, where it is impractical to stamp on the threads, a red band is used. These markings provide quick, positive identification of Byers Wrought Iron nipples, and help to avoid any danger of accidental substitution of non-durable nipples in the line.

IN WELDED SYSTEMS USE WROUGHT IRON WELDING FITTINGS



Wrought iron welding fittings are available in a wide range of types and sizes from leading fitting manufacturers. Just contact your supplier.

Wrought iron nipples are also available from a number of manufacturers. The identification used on such nipples may be learned by consulting the supplier.

INHERENT CORROSION RESISTANCE

The superior resistance of wrought iron nipples comes from the unique composition and structure of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and "detour" corrosive attack, and so discourage pitting. The fibers also anchor the initial protective scale, which shields the underlying metal.

The best guide in applying wrought iron is a knowledge of its character and properties. The complete story is presented in the booklet, "The ABC's of Wrought Iron". Ask for a copy.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, Seattle, San Francisco. Export Division: New York, N.Y.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

BYERS
GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

POWER

PHILIP W SWAIN, EDITOR • JULY 1948 • ESTABLISHED IN 1882

Power for Peace and War

WE DON'T think that war lies just around the corner, or even that it is likely within the next five years; neither Russia nor America could profit by armed conflict.

Yet we can take no chances in this explosive world. We must prepare—to make war less likely and an American victory more certain if war should come.

Fighting men and their weapons are less than half of the picture. Modern war is built on an industrial foundation of raw materials, fuel, production, transportation—given life at every step by some form of power. It's all one big picture, so let's view it as a whole for a moment —in terms of broad national strategy.

New, protected oil sources would be needed—also big stockpiles of manganese, copper, tin, zinc, cordage, palm oil, coconut oil, etc. We would need more steel capacity, a revivified railroad system and plenty of machine tools.

How about power-generating capacity? Put the answer this way: We need a lot more power for peace—and when we get enough power for peace we will probably have enough for war as well. Here, in truth, we can kill two birds with one stone.

Readers will recall that we got through the last war without power shortages despite enormous war production and a very modest increase in generating capacity. This was possible because civilian goods fell off and because existing kilowatt capacity worked overtime generating kilowatt-hours for second and third shifts.

These same factors would apply in another war. Also, power use would again be restricted by the bottlenecks of fuel, steel, transportation and labor, each of which sets a limit on production and hence on power consumption.

The report recently released by Edward Falck, chairman of the Power Board of the National Security Resources Board, bears out this view in its emphasis on the peacetime requirements.

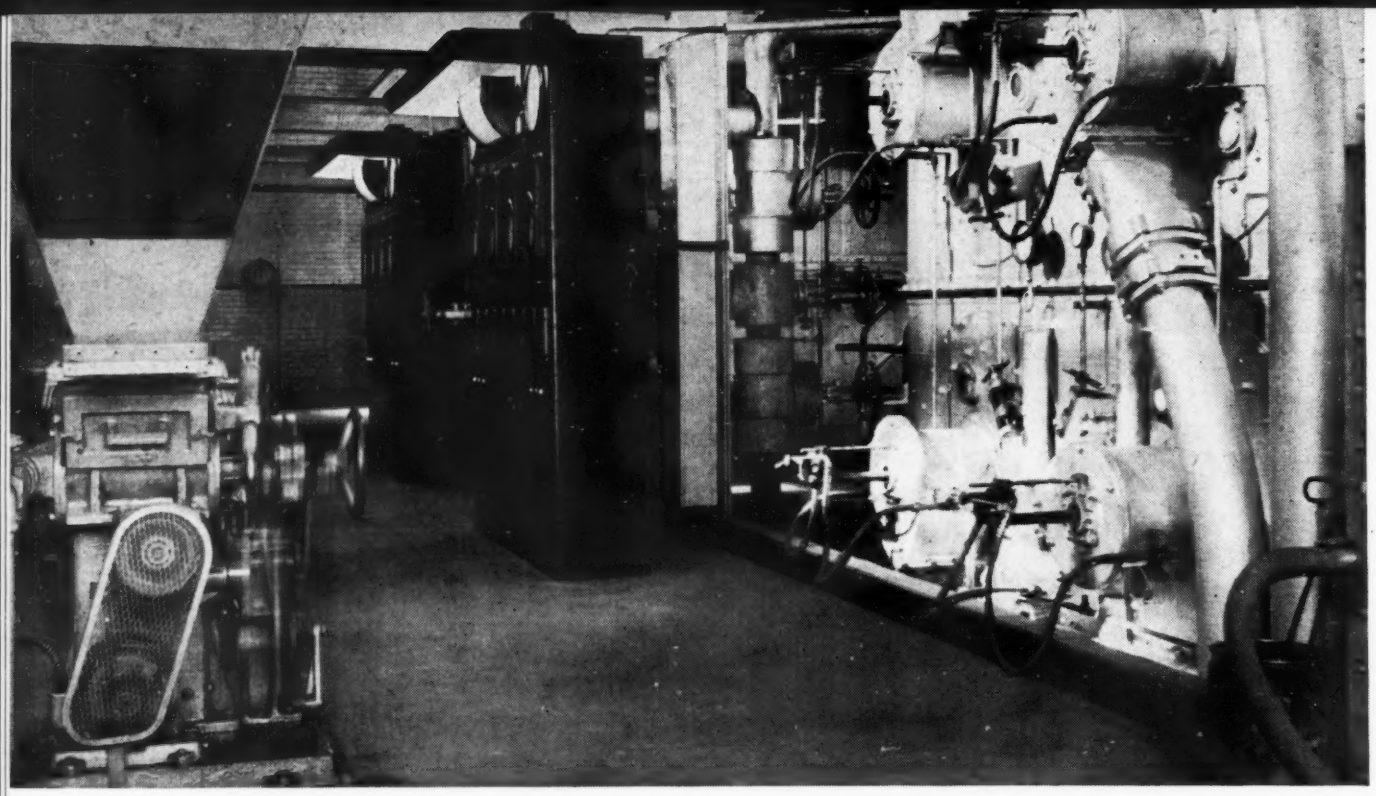
Meeting this peacetime load will be no easy task. It means adding 20,000,000 kw of central-station capacity by 1951 to increase this year's 3.7 percent national margin of capacity over peak to a more comfortable 11.2 percent, with a then total capacity around 70 million kw.

Large steam and hydro turbine-generators still require three years from order to delivery. Orders on the books for units above 10,000 kw are 5.4 million kw for shipment in 1948, 5.6 for 1949, 5.3 for 1950, and only 1.6 for 1951. The moral is clear; get your turbine-generator orders in now for 1951 delivery.

Below 10,000 kw the turbine-generator situation is much easier. Small utilities and industrials won't have to wait too long for their new generating units.

Boilers and other power-plant equipment are available sooner than the generating units and are therefore no bottleneck.

Thinking broadly of power for the nation's needs, the situation may be described as tight but not alarming. And one vital fact is clear: Working hand in hand with government agencies, power men are planning and building the facilities needed to keep the wheels of America turning—in peace and in war.



1 OPERATING AISLE. The two new 100,000-lb-per-hr boilers are arranged so meter and control panels, feedwater valves and stairways, to either the basement or the drum platform and fan room, are in or near passageway between the two boilers

Steam Plant Modernized With

Pulp and paper mill eliminates four old stoker-fired boilers, and superimposes 600-psi 700-F steam and power generators on 170-psi 475-F system. Power-plant design emphasizes reliability, economy, easy operation and provisions for expansion

By W P LONDON, *H. G. Acres & Co, Niagara Falls, Ontario*

▶ MAKING PULP AND PAPER consumes large quantities of steam and electric power. Not only are these items essential to the process, but they also account for a substantial part of the finished product's cost. So it is not surprising that successful pulp and paper mills watch boiler-house and power-plant performance with a critical eye while carefully considering all possible improvements in reliability and economy. Thus Fraser Companies Ltd have recently constructed a new steam plant at their mill in Edmunston, N. B., Canada.

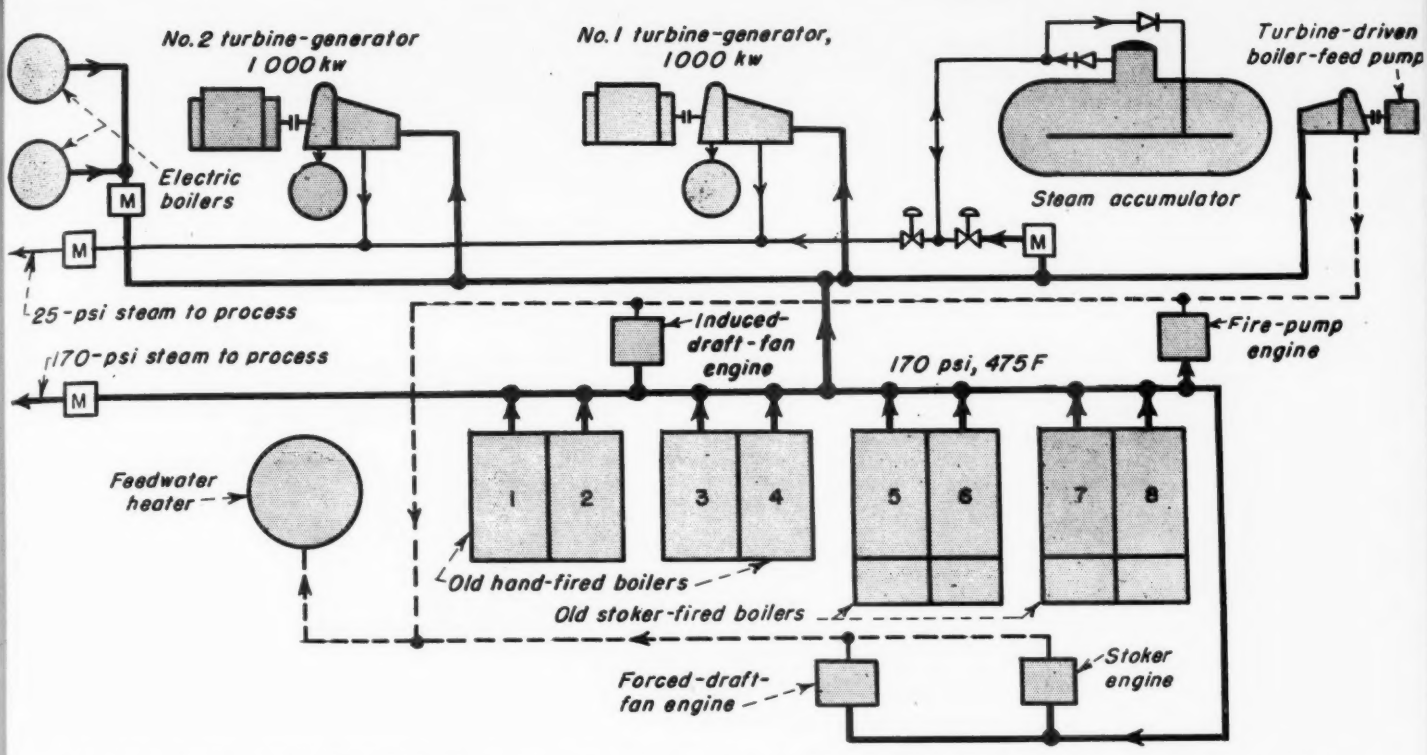
Existing Plant. When the mill was built before World War I, its steam and power facilities were adequate and economical. But 30 years of continuous operation at constantly increasing production rates had their inevitable result. By 1941, the management realized it could meet present and future needs only by making major additions to the equipment. So our firm, H G Acres & Co, undertook a study to determine what equipment to install for best economy and reliability —in cooperation with F O White, chief engineer for Fraser Companies.

Diagram on facing page shows plant hookup in 1941. Pulp-mill steam was supplied at 170 and 25 psi. Boiler installation consisted of eight longitudinal drum boilers, each of 5000-sq-ft steam-making surfaces fired by under-feed stokers. Four, equipped with dutch ovens to burn wood refuse, were designed to operate at 170 psi and 475 F.

A steam accumulator of 23,000-lb storage capacity was installed between the 170- and 25-psi mains. Two 1000-kw extraction-condensing turbine-generators had their bleed points connected to the 25-psi system. These supplemented the main supply of hydroelectric power. Two 2000-kw electric boilers supplied 170-psi steam when surplus hydro power was available.

Proposed Changes. The steam and power study resulted in a decision to modernize the plant in two steps:

1. Install two new 100,000-lb-per-hr steam generators, each designed for 600 psi, 700 F. They could supply full mill requirements but no spare capacity. These units, with auxiliaries and feedwater-treating equipment, were to be housed in an extension to the old plant so they could be installed without interfering with operation. Provision was made for a possible extension for two additional units. The final installation could deliver 300,000 lb of steam per hr, with one unit as a spare. This was regarded as the ultimate plant capacity. Temporarily the new units would operate at 170 psi and connect into the old piping system.



2 OLD PLANT ARRANGEMENT. Steam for pulp mill was supplied at 170 psi from eight longitudinal boilers, each having 5000 sq ft of heating surface, all stoker fired; 4 are equipped with dutch-oven furnaces to burn wood refuse

Eye Toward Future Expansion

2. Remove four old boilers and install a 3500-kw turbine-generator in their place. This work would not be undertaken until the new boilers had operated long enough to make all adjustments so further shutdowns would be unlikely. The four old units with dutch-oven furnaces would serve as spare capacity for the new plant and permit using any wood refuse as fuel. It was not desirable to install new refuse-burning units as it was hoped that, by the time the installation had to be abandoned, more advanced designs would be available.

The turbine-generator was designed for inlet conditions of 600 psi, 700 F and for 170-psi exhaust. It would not develop the total power available from process steam, and space was provided for a second unit of equal capacity. Installing the new power-generating unit in the old building not only effected a considerable saving but also gave a more compact and convenient layout. Diagram on p 67 shows final hookup.

When the decision was made to proceed, material was not available so construction did not start until 1944. Late in 1945 the boiler house was completed and the new boilers placed in operation. The turbine-generator was placed in service in July 1947.

Steam-Generating Units. Boilers have an actual capacity of 87,000 lb per hr each, at 620 psi at the superheater outlet and a total temperature of 700 F. Pulverized-fuel firing is used, designed for bituminous coal from the Minto area in New Brunswick; average proximate analysis is volatile matter 27%, fixed carbon 40%, ash 23% and moisture 10%. Its ash softens at 1900 F, has a grindability of 70 and 10,500 Btu as fired. Sulphur content is generally high. These characteristics were considered in the firing-equipment design.

Each boiler has ample pulverizer capacity in two bowl-type units of 7000-lb-per-hr rating. To insure drying the wet coal, preheated primary air is mixed with a quantity of hot gas drawn from the furnace below the water-cooled ash screen. This gas supplies sufficient heat to permit complete drying under all conditions and to maintain a uniform temperature of the coal-air mixture going to the burners.

These pulverizers have been highly satisfactory. Pulverization is excellent and, even with coal of very high ash content, carbon loss in the refuse is extremely low. All grades of coal are handled without difficulty with low mill-maintenance cost.

To guard against slagging, liberal furnace volumes and furnace-heat-absorbing surface are provided. At full load, heat release is about 23,600 Btu per cu ft and 80,000 Btu per sq ft of projected watercooled surface. Water-cooled surface has fin tubes on the sidewalls and roof with plain tubes and a refractory backing in the front wall. Experience shows the units can operate continuously at rated capacity, with about 30% excess air, without serious slagging.

Each boiler has a plate-type air heater. The coal's flue gas is likely to be corrosive because of high sulphur content, so low gas temperature must be avoided. At full load, exit-gas temperature is about 380 F and corresponding air temperature about 420 F.

Induced-draft fans are motor driven through hydraulic couplings for speed control. Forced-draft fans are also motor driven and have inlet-vane control. Multi-element tubular dust collectors are installed between air heaters and induced-draft fans.

Coal Handling. Coal is delivered by railway. For the old plant, a track

hopper, feeder, crusher, bucket elevator and belt conveyor unloaded and raised coal to the bunkers. In the new plant, complete new handling equipment is not being installed now. The existing hopper, crusher and elevator are used, and an additional cross-conveyor and belt conveyor installed to deliver coal to the new bunkers. Over the bunkers the conveyor is equipped with a self-propelled tripper.

When additional boilers are installed, a new hopper, crusher and elevator can be added to this coal-handling equipment and placed at the opposite end of the building. The old equipment will then be abandoned and the belt-conveyor drive changed to permit feeding it from the new elevator.

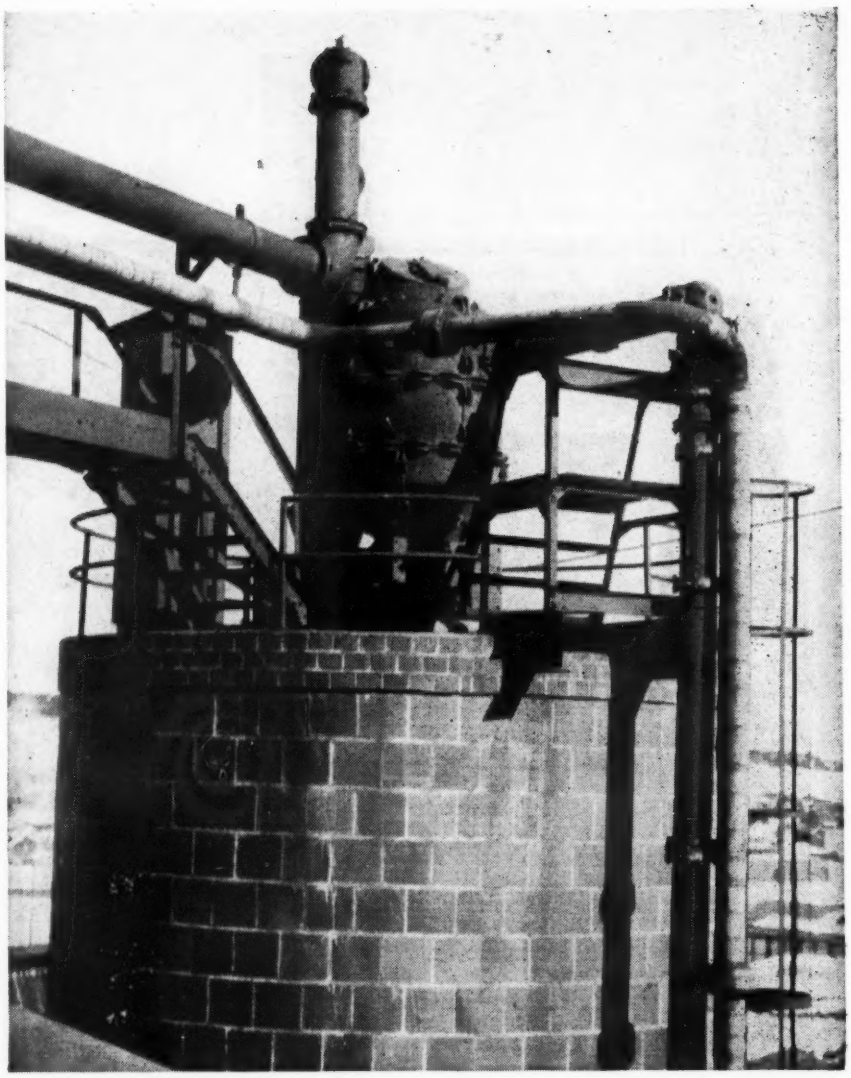
Bunkers of about 30-hr storage capacity are built with hopper bottoms and flat reinforced-concrete sides. Construction is somewhat more expensive than a suspended design, but it eliminates dead pockets. This advantage is important with high sulphur-content coal, which is apt to catch fire from spontaneous combustion if left in storage very long. From the bunker openings, coal discharges through automatic scales to the pulverizer feeders on the operating floor.

Ash Handling. Ashes, from furnace bottoms, boiler's last-pass hopper, and from dust-collector storage bins, are handled by a pneumatic conveyor system, discharging to a 100-ton tile storage tank. A steam ejector produces the vacuum. A mechanical blower was considered but the higher initial expense and maintenance costs would more than offset its lower operating cost.

Pushbutton stations, conveniently near the ash intakes, control a valve in the exhauster steam line of the conveyor system. Its operation is simple, clean and convenient.

Feed Pumps. Two high-pressure feed pumps, one turbine- and one motor-driven, have sufficient capacity each to supply both boilers. The turbine-driven unit normally operates when available on 170-psi steam and exhausts at 25 psi. The motor-driven pump operates to start the plant or when the turbine-driven unit is out for repairs.

Two low-pressure feed pumps in the new plant, both motor-driven, supply water to the old boilers. During low-pressure operation of the new boilers, the turbine-driven high-pressure pump was also used, operated at reduced speed. All feed pumps are in the basement directly under the deaerator. A story of the feedwater-treating system will be published in an early issue.



3 ASH-HANDLING SYSTEM. Ashes from the furnace bottoms, the boiler's last-pass hoppers and from the dust-collector storage bins are handled by a pneumatic conveyor system, which discharges to a 100-ton storage tank made of tile

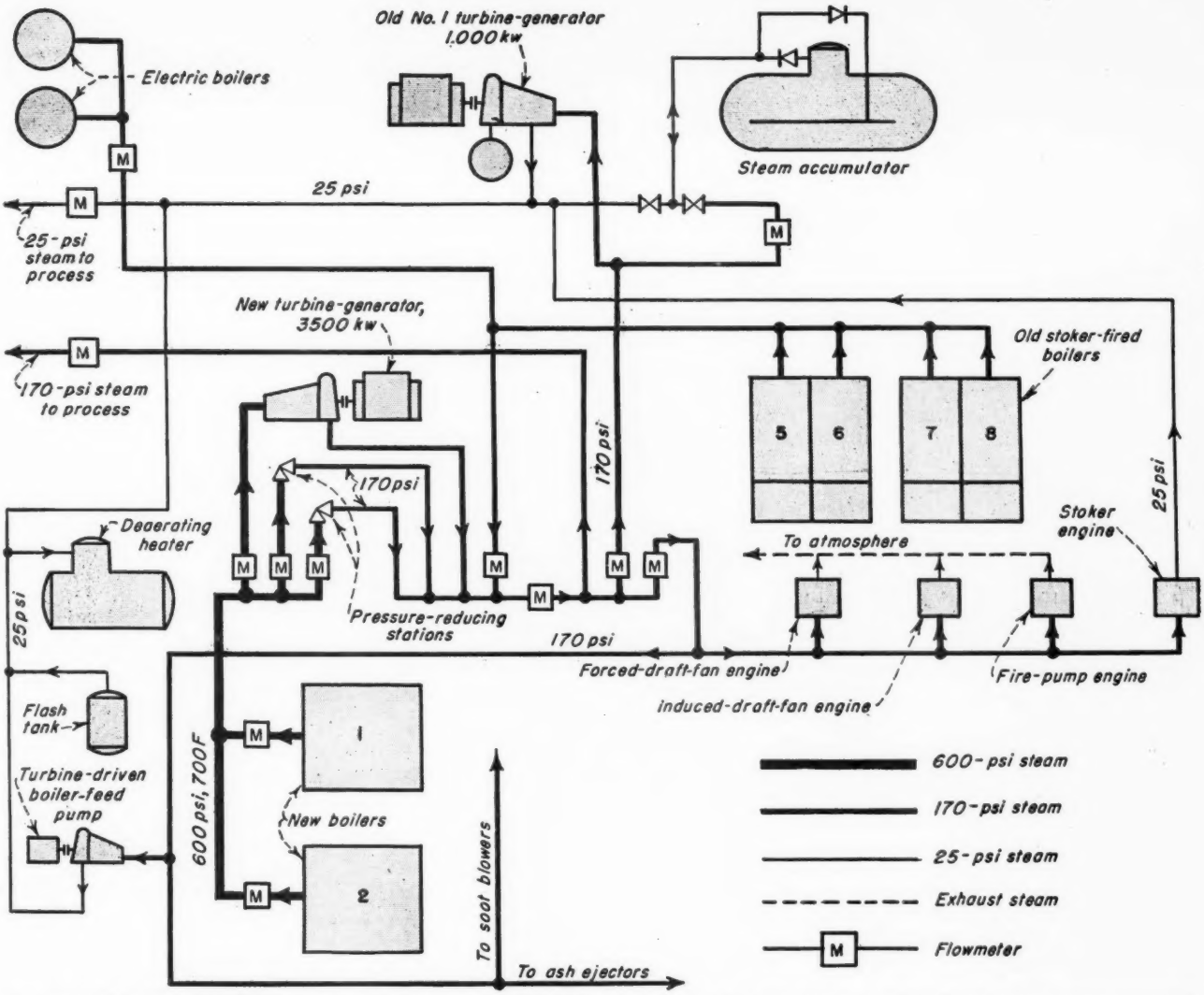
Turbine Generator. Built in Switzerland, the turbine-generator is an impulse-reaction backpressure unit, rated at 3500 kw at 600-psi 700-F inlet-steam conditions and 170-psi exhaust. Power is generated at 6600 v, 3-phase, 60 cycles.

The governing system is interesting. A pump geared to the turbine shaft and equipped with a spring-loaded relief valve supplies control and lubricating oil at constant pressure. A pressure connection, from the pump discharge through an adjustable orifice, goes to individual piston operators on the steam-inlet valves. A bleed valve, operated directly by the governor weights, controls pressure in this line. A drop in speed closes this bleed valve, thereby allowing pressure at the inlet valves to build up and open them. These double-seated, balanced valves are spring-loaded so they open in sequence as oil pressure rises. The entire system is simple and free of mechanical linkages.

The turbine shaft is sealed where it passes through the casing with labyrinth glands, through which an appreciable quantity of steam is permitted to pass. This steam is piped to a small surface condenser in the treated-water line where most of the heat is recovered. The generator has a closed air-cooling system in which raw water is used in the air cooler.

Meters and Controls. As the diagram on p 67 shows, a fairly complete system of steam-flow meters was installed. Consideration was given to this in making the piping layouts to provide suitable orifice locations. The boilers have automatic control.

As mentioned, the old plant included a steam accumulator, connected be-



4 NEW BOILERS, TURBINE. Two new boilers, rated 100,000 lb per hr, 600 psi and 700 F, were installed and put in service at 170 psi. Next, 4 stoker-fired boilers were removed; 3500-kw 600-psi turbine-generator was put in their space

tween the 170- and 25-psi mains. By absorbing temporary surpluses of 170-psi steam and making up deficiencies in the supply of 25-psi steam, the accumulator served to iron out fluctuations in the total process demand. This permitted operating the old stoker-fired boilers at fairly constant load, an important factor in their performance, but less so with the new installation. But the accumulator was useful enough to warrant continuing it in service, which required a slight departure from normal operation.

With the accumulator in service the boilers can operate at constant load. It is necessary, however, to set the load manually by adjustment of the master selector valve. Pressure in the 600-psi header is then controlled by the 600- and 170-psi reducing valves, which operate from a pressure controller connected to their inlet side. Pressure in the 170-psi system is under control of the accumulator, which automatically accepts steam from the 170-psi line or delivers it to the 25-psi line to maintain constant pressure.

When the accumulator is out of service provision is made for conventional operation—that is, with the 600-psi pressure controlled from a master pressure controller operating on the boiler firing rate. Reducing valves then control the 170-psi pressure through a pressure controller connected to their outlet side.

Electrical Equipment. All motors of 1-hp rating and over are operated on 550-v 3-phase current, smaller motors on 220-v 3-phase. All 550-v motor starters, except for the high-pressure feed pump, are combination fusible type, located in a single room. Besides providing convenient maintenance, combination magnetic contactors with fused disconnect switches proved economical since they serve to limit short-circuit currents to values that fuses can handle safely.

The starters are divided between two buses, each supplied by two feeders from the main bus. A fifth feeder supplies the motor on the high-pressure feed pump.

Motors for induced-draft fans, forced-draft fans, pulverizers and coal feeders are interlocked so they must start in the order named. Failure of one motor automatically stops those succeeding it in the sequence given.

Auxiliary equipment is divided between the two buses so a fault on one bus will not cause a complete plant shutdown.

An oil circuit breaker of 250,000-

kva interrupting capacity connects the generator to the main 6600-v mill bus. This breaker is in a steel cubicle near the generator terminals. All controls are in the main switching room, in the ground-wood mill some 300 ft from the steam plant. Overcurrent, differential and field-ground relays protect the generator.

General Layout. The two new boilers are arranged so control panels, feedwater-regulating valves and stairways, to either basement or drum platform and fan room, are in or near the passageway between the units. This arrangement aids efficient operation by placing the operator within easy reach of his equipment. When two additional boilers are installed they will duplicate, as nearly as possible, the present arrangement of equipment.

There is ample room around all equipment for maintenance and operation and, while no effort was made to "dress up" the plant, the general appearance is good. An important factor is the painting scheme; the system developed by Pittsburgh Plate Glass Co, and known as "color dynamics," has been followed when doing this work.

PRINCIPAL STEAM AND ELECTRICAL EQUIPMENT

Steam and Power Plant, Fraser Companies

STEAM-GENERATING EQUIPMENT:

Boilers, superheaters.....Combustion Engineering Co
Boilers, 2; bent-tube, 2-drum, watercooled furnace; 9059 sq ft of heating surface in each boiler; 1765 sq ft in waterwalls; rated continuous steaming capacity 100,000 lb per hr; 620 psi at superheater outlet; 700-F total steam temperature; 8000 cu ft furnace volume; 23,600 Btu full-load heat release per hr per cu ft furnace volume; 80,000 Btu full-load heat release per hr per sq ft of projected watercooled furnace surface
Air heaters .....Combustion Engineering Co
Plate type, 7600 sq ft heating surface
Boiler-supporting steel, casings, ducts and breechings
Combustion Engineering Co
Soot blowers .....Vulcan Soot Blower Co
Chimney .....Custodis Canadian Chimney Co, Ltd
One: radial brick, 9-ft inside diameter, 225 ft high

COMBUSTION EQUIPMENT:

Automatic combustion control.....Bailey Meter Co
Coal pulverizers, feeders and primary air blowers
Combustion Engineering Co
Pulverizers, 2 per boiler; bowl type, 7000 lb per hr each; coal grindability 70; proximate analysis %: volatile 27, fixed carbon 40, ash 23, moisture 10; ash-softening temperature 1900 F
Coal-pulverizer and primary-air-fan motors....Canadian G-E Co, Ltd
4: 50 hp, 550 v, 1800-rpm, squirrel cage
Pulverizer-drive-motor starters.....Canadian G-E Co, Ltd
Coal-feeder controllers.....Bailey Meter Co
Pulverized-coal burners.....Combustion Engineering Co
Circular, 4 per boiler, 3500 lb per hr
Automatic coal scales (Richardson).....Peacock Bros, Ltd
Forced-draft fans.....Canadian Sirocco Co, Ltd
One per boiler, motor driven, vane control, 27,500 cfm, 7.5-in. wg
F-d fan motors.....Canadian G-E Co, Ltd
2, 75 hp, 550 v, 1760 rpm, squirrel cage
F-d-fan motor starters.....Canadian G-E Co, Ltd
Induced-draft fans .....Canadian Sirocco Co, Ltd
One per boiler, motor driven, hydraulic-drive speed control, 55,800 cfm, 9.63-in. wg
Hydraulic drive, scoop control.....Canadian Sirocco Co, Ltd
I-d fan motors.....Canadian G-E Co, Ltd
2, 100 hp, 550 v, 870 rpm, squirrel cage
I-d-fan motor starters.....Canadian G-E Co, Ltd

COAL AND ASH-HANDLING EQUIPMENT:

Coal conveyors, 2, 20-in. troughed belts.....United Steel Corp, Ltd
Coal-conveyor motors.....Canadian G-E Co, Ltd
Coal-conveyor motor starters.....Canadian G-E Co, Ltd
Dust collectors .....Precipitation Co of Canada, Ltd
One per boiler, multicone, 43,500 cfm, 390 F, 3-in. draft loss
Ash conveyor, pneumatic.....Taylor Engrg & Const Co
Ash-storage tank, 100-ton capacity, tile....Taylor Engrg & Const Co

VALVES, PIPING AND TRAPS:

Safety valves, boilers.....Crosby Steam Gage & Valve Co
Safety valves, reduced-pressure lines.....Hopkinsons, Ltd
Nonreturn valves .....Crane, Ltd.
Blowdown valves .....Edwards Valve & Mfg. Co
High-pressure valves.....{Hopkinsons, Ltd / Crane, Ltd}
Low-pressure valves .....T McAvity & Sons
Pressure-reducing valves, desuperheaters....Schutte & Koerting Co
Controls for reducing valves and desuperheaters....Bailey Meter Co
Fabricated piping .....Crane Co, Ltd
Pipe insulation .....Canadian Johns-Manville Co, Ltd
Steam traps .....Canadian Fairbanks-Morse Co, Ltd

FEEDWATER SYSTEM:

Water conditioning (Hall Laboratories)....Dominion Flow Meter Co
Water columns .....Reliance Gauge Column Co
Feedwater control, 3-element, air-operated.....Bailey Meter Co
Mechanical equipment and piping for coagulation and filtration installations .....Roberts Filter Co of Canada
Filter-flow-ratio controllers .....Simplex Valve & Meter Co
Acid-, ferrisul-, soda-feeding equipment..Roberts Filter Co of Canada
Water softeners.....Permutit Co of Canada
2: 7 ft, 6-in. diameter, 125-psi working pressure
Degasifier .....Permutit Co of Canada
Deaerating heater, one, horizontal, spray-type..Permutit Co of Canada
200,000 lb per hr; oxygen not more than 0.005 ml per liter
Continuous blowdown.....Permutit Co of Canada
Phosphate-feed pumps .....Milton Roy Co
Blowdown tank .....Dominion Bridge Co, Ltd
One: 3½-ft diameter, 7¼-ft length, 325-psi working pressure
Acid-storage tank .....Dominion Bridge Co, Ltd
Clearwell pumps, 2, Worthington, 6-stage.....John Inglis Co, Ltd
Motor-driven, vertical-shaft, deepwell, 550 gpm, 210-ft head
Clearwell-pump motors.....U. S. Electrical Motors
2, 15 hp, 550 v, 1760 rpm, squirrel cage
Clearwell-pump motor starters.....Canadian G-E Co, Ltd
Low-pressure feed pump.....Canadian Ingersoll-Rand Co
One, all iron, 2-stage, motor-driven, 500 gpm, 650-ft head
Feed-pump motor .....Canadian G-E Co, Ltd
One, 25 hp, 550 v, 3540 rpm, squirrel cage
Feed-pump motor starters.....Canadian G-E Co, Ltd
High-pressure feed pumps.....Canadian Ingersoll-Rand Co
One turbine-driven and one motor-driven:
Turbine-driven pump: 6-stage, 500 gpm, 1725-ft head, 3540 rpm
Turbine (to drive feed pump).....Moore Steam Turbine Div
325 hp, steam conditions 170-psi throttle, exhaust 25 psi
Motor-driven pump : 6-stage, 600-gpm, 1725-ft head, 3450 rpm
Motor (to drive feed pump).....Canadian G-E Co, Ltd
400 hp, 550 v, 3540 rpm, squirrel cage
Motor starter .....Canadian G-E Co, Ltd
Brine pump.....Canadian Ingersoll-Rand Co
One, motor-driven, all bronze, 20 gpm, 50-ft head

METERS:

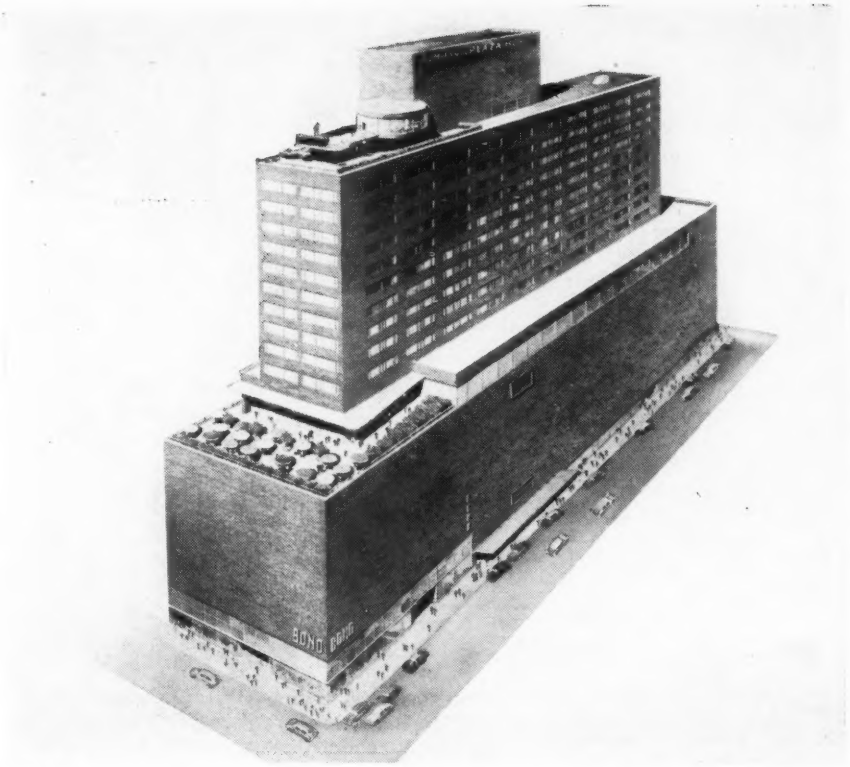
Boiler-meter and control panels.....Bailey Meter Co
Boiler meters, steam flowmeters, pressure and temperature recorders, feedwater flowmeters, blowdown meters, boiler-water-level recorders, boiler-load indicators, 10-pt draft gages..Bailey Meter Co
Thermometers, industrial.....Taylor Instrument Cos of Canada
Pressure gages, (Ashcroft).....Mechanical Equipment Co, Ltd
Turbine pressure and temperature recorders.....Bailey Meter Co

POWER-GENERATING EQUIPMENT:

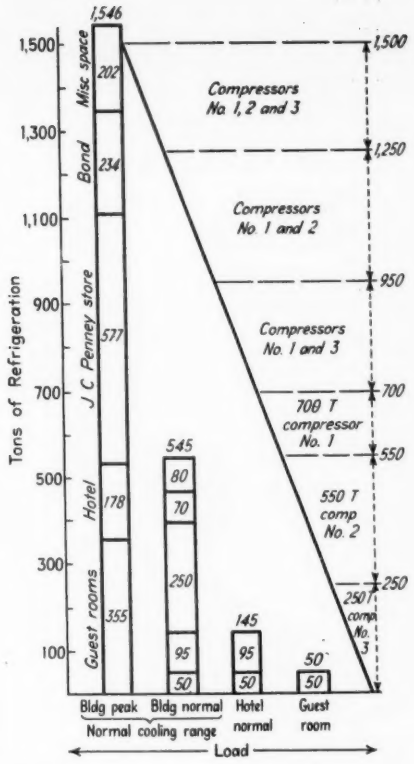
Turbine-generator.....Brown Boveri (Canada) Ltd
One, 3500 kw, 3600-rpm, backpressure turbine; throttle conditions, 600 psi, 700 F, exhaust 170 psi. Generator, 4750 kva, 0.80 pf, 6900 v, 60 cycles, 3-phase
Air cooler.....Brown Boveri (Canada) Ltd
Gland condenser .....Foster Wheeler, Ltd
Switchboard.....Canadian Westinghouse Co, Ltd
Generator oil circuit breaker.....Canadian Westinghouse Co, Ltd
One, 250,000-kva interrupting rating at 7500 v
Generator control, protective equipment and voltage regulator
Canadian Westinghouse Co, Ltd
Turbine-room crane.....Herbert Morris Crane & Hoist Co

MISCELLANEOUS:

Vacuum-cleaning system.....Sheldons, Ltd
Instrument and control air compressor.....Gardner-Denver Co
One, motor driven, 6½x5½ vertical duplex, single-stage, watercooled, 135 cfm, 100 psi



1 Application of a central refrigeration system to air-conditioning a heavily glassed 10-story hotel and a windowless 7-story department store means special design



2 Various load combinations and equipment scheduling makes above chart

Central Refrigeration Handles Load

Terrace Plaza Hotel, Cincinnati, sets atop a 7-story department store. Handling air-conditioning loads from many sources, says H C Hoffman, project engineer, Carrier Corp, calls for smart planning, full, effective equipment use, good controls

▶ PUT A 10-STORY HOTEL on top of a 7-floor department store and you can expect unusual air-conditioning application problems. Load varies from a low of supplying summer-evening cooling for hotel rooms only, to the anticipated 1500-ton peak imposed by both store and hotel demands.

These demands differ considerably. For example, the lower 7-floor section of the building, Fig. 1, is of windowless construction whereas the 10-floor upper division has a widespread use of glass. Over and above the space differences these present, there are a 400-seat cafeteria and a number of small independent shops in the first floor and basement areas.

Single Refrigeration Source. Central refrigeration for all air-conditioning purposes is supplied by three centrifugal compressors in the sub-basement. Maximum flexibility, with respect to anticipated 1500-ton peak load and the many variations of load, is met by a combination of three different-sized compressor units, Fig. 2. Electric motors drive these three machines (250-, 550- and 700-ton units) through gear reducers to supply the desired capacity variation. In addition, drum-controller starters give five balanced points of speed operation on individual compressors. All three machines through a series of interconnections feed a main chilled-water loop. This interconnection permits any one or all units to meet the refrigeration load.

The main chilled-water loop, a 12-in. line, handles up to 2400 gpm from two of three 1200 gpm, 60-ft head pumps. From this central supply loop, Fig. 3, separate pumps draw chilled water for either hotel or store loads. Two pumps of 800 gpm deliver water at an 80-ft head to the store system. A third similar-sized pump furnishes the hotel needs at again an 80-ft head. Cross-connected piping permits a fourth pump of 800-gpm rating to act as a common standby.

Now for the hotel and store systems themselves. Separate supply and return lines are used for each—a 10-in. one for the stores and an 8-in. line for the hotel. The load divides about 1000 tons for stores and 500 for hotel. Completely separate systems for these major divisions of load enable the central refrigeration system to supply either one load alone or both.

A central shaft distributes chilled water to the various main air-conditioning fan rooms. These rooms are in the

sub-basement, second, sixth, seventh, eighth and penthouse floors. The seventh-floor fan room serves the primary-air system for hotel guest rooms.

A cooling tower on the roof provides condensing service for circulating cooling water to the centrifugal compressor condensers. This tower can cool 4500 gpm of water from 95 to 85 F at a peak outside wet bulb of 78 F. It is a twin cell, induced-draft unit of all-steel construction with double-deck spray heads—one bank with and one opposed to the air stream.

Three 2250-gpm pumps, including one standby, located in the sub-basement deliver at a 130-ft head, circulating water to the tower.

Fan Rooms. Conventional air-conditioning apparatus in fan rooms include (1) centrifugal-type fans, both single and double inlet (2) steam preheater and reheater coils (3) spray-coil dehumidifiers (4) electrostatic air filters.

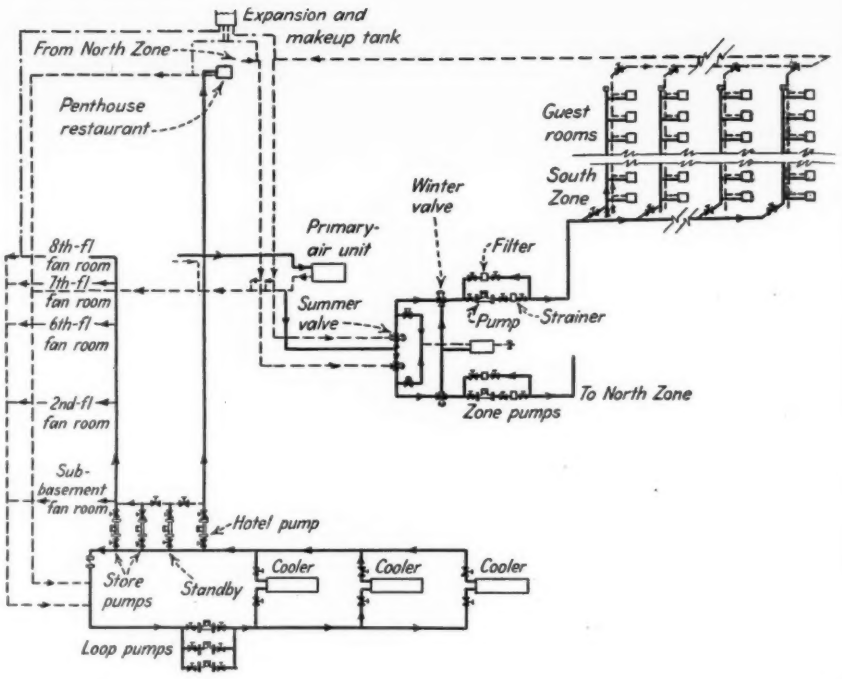
Four separate systems, employing a positive combination return and exhaust fan in addition to a supply fan, operate from a typical fan room. These combination return-and-exhaust fans balance supply air to the space and remove exhaust from toilets, etc. Air supplies for space needs include ventilation plus exhaust losses.

Ventilation presents somewhat of a problem. Usually additional air must be introduced to system circulation to make up for exfiltration losses. The vault-like construction of the windowless store changes the exfiltration factor considerably. The balanced combination return and exhaust fans furnish a solution to this situation.

The typical fan room acts as an exhaust plenum since the four positive return-exhaust fans spill excess air there. Propeller-type fans in the south wall draw this excess air out.

Filtering Air. All air passes through filters. A system of auxiliary return-air dampers reintroduces some return air to a portion of the electrostatic filters. The amount of dual duty these filters serve depends upon the amount of ventilation. Savings in both space and money result from this ability to set up a dual-duty service.

Controls for all systems operating from a typical main fan room are pneumatic. Every effort was made to reduce these controls to their simplest form. For instance, positive-acting dampers operate in all cases except for space-temperature control. In this service, face and bypass dampers are used. The positive-acting damper gives an almost constant air flow, which eliminates the need for static pressure regulation used on modulating dampers.



3 Chilled-water flow diagram shows main loop acting as supply source for hotel and store pump loads. Cross piping enables standby pump to serve either load

Carrying out this simplification idea further, no 3-way valves have been put in the chilled-water circuit at the spray-coil dehumidifiers. Instead, a balance for a water flow to meet peak load was set in the field and is held constant by lubricated plug cocks. This holds the hydraulic system constant.

A manual-control arrangement in the basement regulates chilled-water temperature on a schedule based on outside wet-bulb temperatures. As the wet bulb increases, water temperature lowers, and vice versa. This results in an approximate dewpoint sufficiently accurate for summer-humidity control. Practically all thermostats have been located in the fan rooms rather than in occupied areas. This makes controls more accessible to the operator and less so to the tenant since it is felt that better over-all operation results.

Store Controls. Control system for store space includes: (1) return-air thermostat for operation of dampers (face and bypass) and steam reheater coil in sequence (2) thermostat on dehumidifier leaving side to modulate steam preheaters for a dewpoint of about 40 F (3) return air hygrostat for maintaining winter-humidity limit at 35% by controlling recirculating spray pumps (4) safety thermostat next to the dewpoint thermostat, set at 38 F to shut down the supply fan in case of steam preheater failure and keep the water coil from freezing (5) pressure electric switches to start return-air fans, propeller-type exhaust fans and electrostatic filters when the supply fan starts.

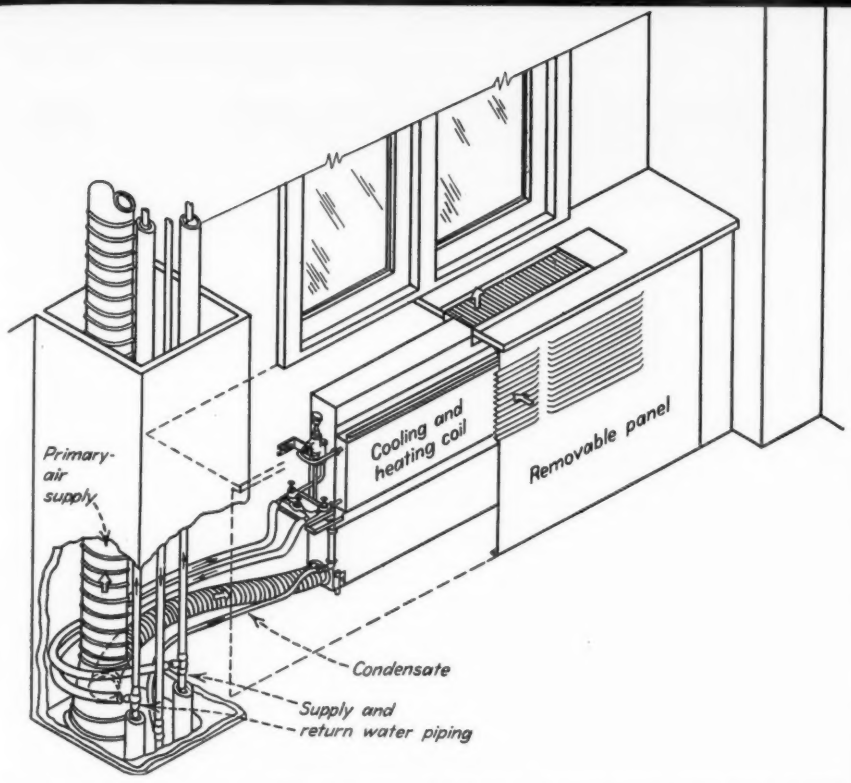
The return-air thermostat with a fall in temperature causes the face damper to close to its minimum position after which the reheater valve opens. A rise in temperature brings about the reverse. This cycle works both winter and summer. Sprayed coils make the dehumidifiers a cooling source whether or not chilled water is circulating through the coils.

Guest Rooms. A 3-element conduit setup supplies air conditioning for guest rooms. These elements are a primary-air system, a water-circulating arrangement and an outlet unit under the windows in each guest room.

The primary-air system originates in the seventh-floor fan room. It has two separate zone fans, north and south. This apparatus provides the necessary outside air for ventilation treated according to season—humidified in winter, dehumidified in summer.

Conditioned outside air goes through a series of round headers, which distribute it to the perimeter of the building. Risers in the center of each bay take it up the building. A typical riser serves two units per floor by means of branch runouts, which deliver primary air to the unit base.

Two zone pumps—one each for north



4 Special guest-room window units receive hot or cold modulated water from pumps under action of 3-way pneumatic valves actuated by outside zone thermostats

and south—feed hot or cold water to the coils of the window units, Fig. 4, in accordance with summer-cooling or winter-heating demands. Both cycles use modulated water temperatures in accordance with exposure demand by means of 3-way pneumatic control valves, actuated by outside-zone thermostats. These outside-zone thermostats automatically position summer and winter 3-way valves to give required cooling or heating. Such a control regulates water temperature to windows in a zone in keeping with the actual requirements of exposure as they develop.

A manual control on the unit in each room permits the occupant to regulate water flow through that particular coil. Primary-air flow across these coils issues from high-velocity jets in the mixing stack. The action of the jets sets up an induced draft that pulls room air across the coils at a volume of about three times that from the jets themselves. Both streams —air-jet-propelled primary air plus induced room air—mix and discharge through the grille in the window stool.

Chief advantages of the hotel-room system described are: (1) Each room is independent. No return air circulates so odors are not recirculated. Outside air from the room unit exhausts through the bathroom, thus isolating the room. (2) Air circulation stays constant despite load fluctuation. Water-flow changes meet these load variations. So a constant pattern of air distribution, as well as adequate ventilation, results. (3) Guest can regulate temperature to suit his own taste. (4) Absence of horizontal ducts with a vertical distribution system made possible 9-ft 9-in. floor-to-floor rooms to give one additional floor within the limits established by the building zone ordinance.

Hotel corridors have a separate conventional supply and exhaust system for the small amount of cooling and ventilation they need.

PRINCIPAL REFRIGERATION AND AIR-CONDITIONING EQUIPMENT

Terrace Plaza Hotel of Cincinnati, Ohio

REFRIGERATION EQUIPMENT, AUXILIARIES

Centrifugal compressors ..... Carrier Corp
3 (700, 550 and 250 tons) motor driven through gear reducers
Compressor motors ..... Crocker-Wheeler Elec Mfg Co
3 (700, 600 and 250 hp) wound rotor, 1750 rpm, 208 v, 3 phase, 60 cycle
Gear reducers ..... Falk Corp
3 (700 hp, 1770 to 3938 rpm; 600 hp, 1775 to 4959 rpm; 250 hp, 1770 to 6278 rpm)
Motor starters ..... Cutler-Hammer, Inc
3; drum controllers, 5 balanced points
Pumps, 3, 1200 gpm, 60-ft head, 25-hp motors ..... Peerless Pump Div
One acts as standby serving 12-in. loop; chilled-water service
Pumps, 4, 800 gpm, 80-ft head, 25-hp motors ..... Peerless Pump Div
2 serve stores, 1 the hotel, 1 standby; chilled-water service
Piping ..... Carrier Corp
12-in. main chilled water loop; 10-in. stores supply and return; 8-in. hotel supply and return—all chilled-water service
Valves, chilled-water service ..... Wm Powell Co
Pumps, 2, Weathermaster ..... Peerless Pump Div
North zone: 260 gph, 60-ft head, 7½-hp motor. *South zone:* 312 gph, 75-ft head, 10-hp motor
Pumps, 3, condensing water ..... Peerless Pump Div
2250 gpm, 130-ft head, 100-hp motor. One acts as standby
Cooling tower, 1, condensing water ..... Marley Co, Inc
Induced draft, all steel, 4500 gph

FANS

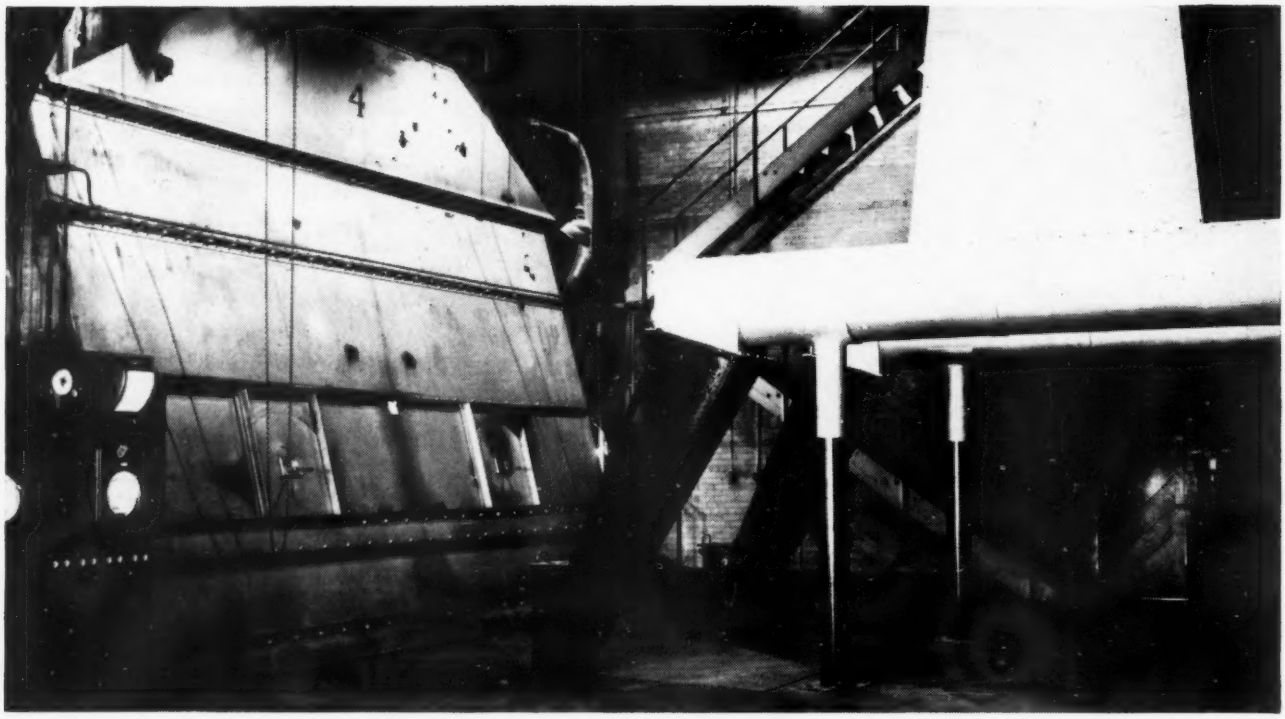
Air-conditioning service ..... Buffalo Forge Co
Positive return—exhaust centrifugal type, 15; total 258,000 cfm; 4 double inlet, 11 single inlet
Supply centrifugal type, 16; total 381,500 cfm, 8 double inlet, 8 single inlet
Supply fans, Weathermaster, 2; total 30,144 cfm—high-speed centrifugal heavy duty
Spill-duty propeller exhaust, 8; total 90,700 cfm
Ventilation fans ..... Buffalo Forge Co
Supply—centrifugal type, 9; total 111,900 cfm, single inlet
Exhaust—centrifugal type, 29; total 244,920 cfm, single inlet
Supply and exhaust—propeller type, 5; total 18,000 cfm

DEHUMIDIFIERS, HEATERS AND AUXILIARIES

Dehumidifiers ..... Carrier Corp
38; Type 29 R spray coil dehumidifiers with 6-row 6-pan coils, total 276,000 cfm deh air
Steam coils ..... Aerofin Corp
Steam preheaters—distributing-tube Type F, 49
Steam reheaters—distributing-tube Type F, 57
Unit heaters ..... Carrier Corp
Centrifugal-fan type, 10; propeller-fan type, 5
Boilers ..... Babcock & Wilcox Co
3; 200 psi, 30,000 lb per hr, gas or oil fired
Electrostatic-type filters ..... American Air Filter Co, Inc
18, total 424,000 cfm
Multipanel oil filters—traveling-screen type, 5, total 60,600 cfm
American Air Filter Co, Inc
Banks of Throaway-type filters ..... Owens Corning Fiberglas Co
9, total 58,000 cfm
Thermostats ..... Johnson Service Co
81: 16 dewpoint type in apparatus, 21 duct type in return air 44 room type
Hygrostats ..... Johnson Service Co
15: 11 duct type in return air, 4 room type
Radiant heating—Gourmet Room ..... E J Nolan Corp
1700 lineal ft of ¾-in. welded pipe with 465 sq ft of surface

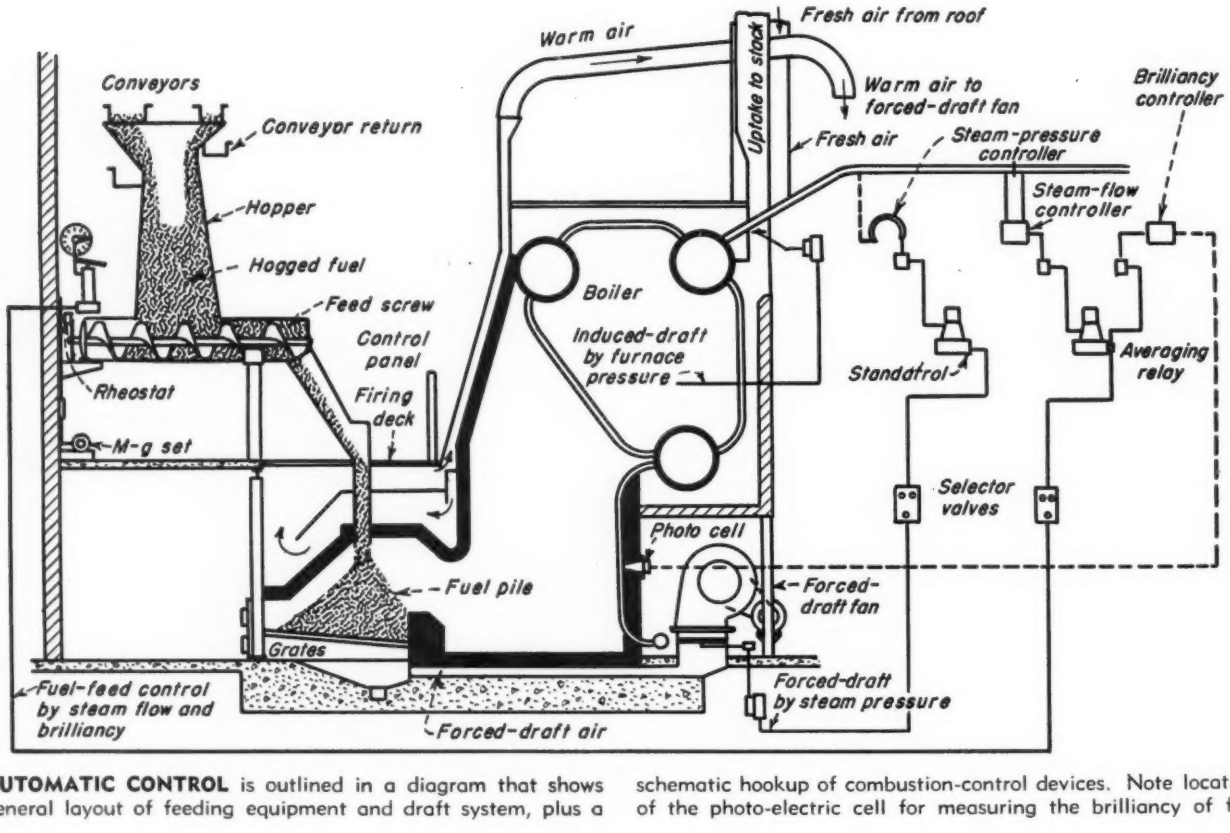
CONSULTING ENGINEERS

Heating, ventilating, air conditioning ..... Jaros, Baum & Bolles

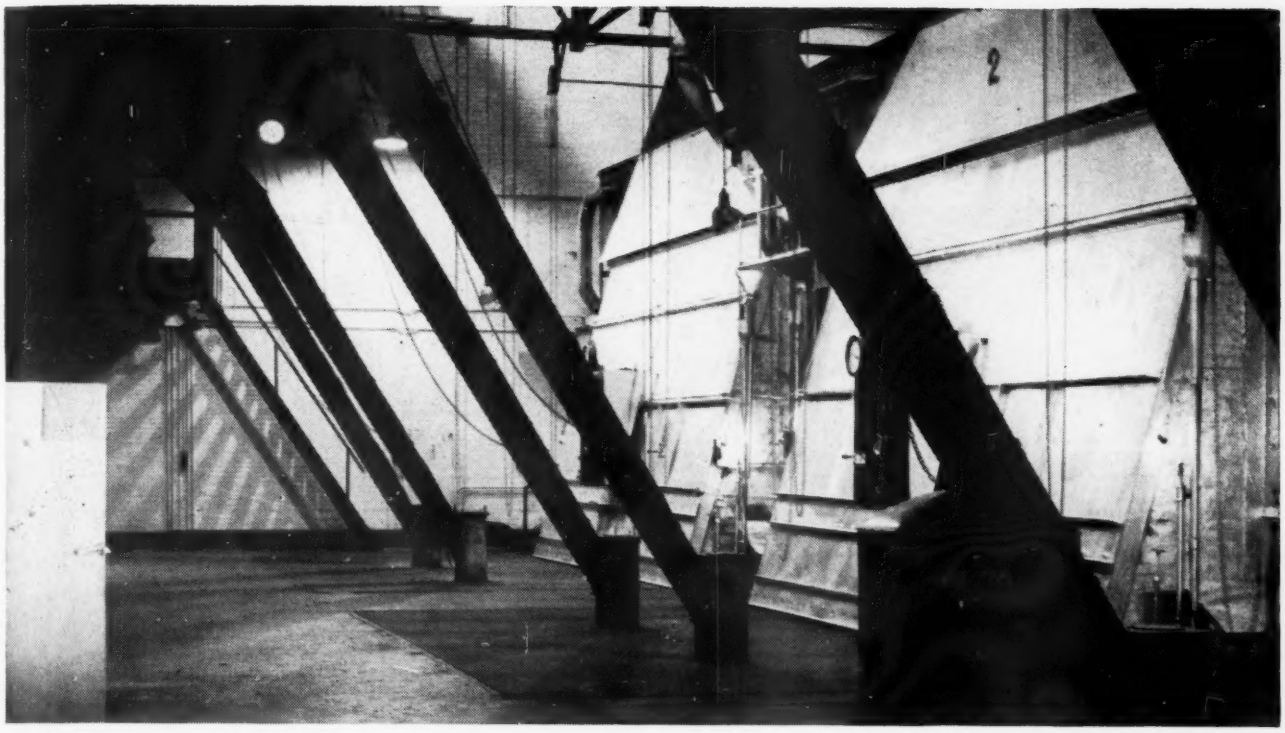


AUTOMATIC FEEDING is accomplished by a variable-speed screw in a trough under a hopper supplied from overhead conveyors. Complete filling of screw feeder shuts off excess air to the furnace tops; thus the air-fuel ratio may be controlled

Automatic Feeding of Woodwaste



AUTOMATIC CONTROL is outlined in a diagram that shows general layout of feeding equipment and draft system, plus a schematic hookup of combustion-control devices. Note location of the photo-electric cell for measuring the brilliancy of fire



HAND FIRING, even in a relatively up-to-date wood-burning boiler plant like this, is inefficient because an uncontrolled amount of excess air may enter through fuel chutes. High velocity of fuel from conveyors to grate causes pile to pack

Replaces Hand Firing, Saves Fuel

Control system developed at Klamath Falls plant, Weyerhaeuser Timber Co, uses fire's brilliancy to adjust automatically for differences in fuels, holds air-fuel ratio constant for smoke-free combustion. Harry Panning, mech supt, tells how it works

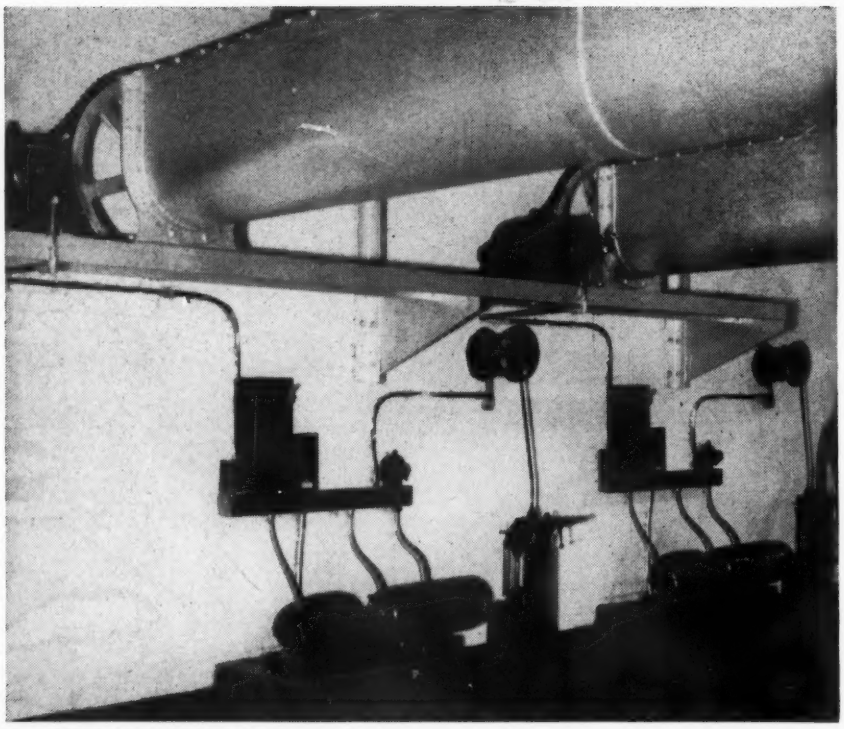
▶ WHEN CHANGING CONDITIONS made woodwaste scarce, higher efficiencies than could be obtained with hand firing were needed, at the Klamath Falls, Oregon, plant of Weyerhaeuser Timber Co. In collaboration with Bailey Meter Co, we developed automatic feeders and controls for the steam generators. This system includes measurement of fire brilliancy as a regulating factor in fuel-feed control.

Changes in the fuel situation that encouraged this development are being felt throughout the lumbering industry. The day is rapidly disappearing when disposal of woodwaste, consisting of sawdust, planer shavings and hogged fuel (chipped slabs), represents a troublesome and often expensive problem for the lumber manufacturer. In the past, a small part of the waste served as fuel for steam generation while the remainder was disposed of in any way possible, often by incineration. Now, new developments on the one hand reduce amount of waste resulting from mill operations and, on the other hand, make the waste that is produced valuable for a variety of purposes.

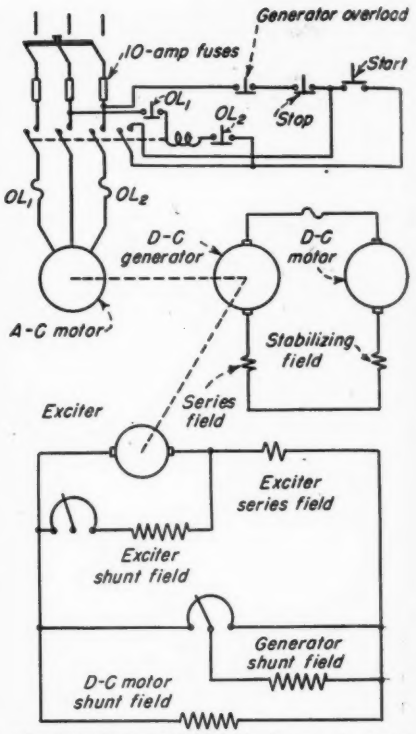
Not a Waste Product. Power plants in the wood industries today thus burn a fuel that often has real economic value, instead of a waste product to be disposed of by the least expensive means, which usually proved to be firing under a boiler. In many modern mills, supplementary fuels, such as oil and coal, must be burned because woodwaste supply for fuel purposes is inadequate. Accordingly, conditions are beginning to put a premium on combustion efficiency whereas it might be fairly said that in the past there was a premium on inefficiency.

Usual Setup. In the commonest arrangement, woodwaste is fired on a flat or slightly inclined grate in a dutch oven, or extension furnace. Most relatively modern plants have an overhead conveyor running through the boiler room, and the one or more dutch-oven cells are fed by chutes (see photo above). Amount of fuel fed is controlled by an opening with a slide, in the bottom of the conveyor. This is operated by the fireman, who walks along the furnace tops, looking down on the fuel piles, and decides when to add fuel according to his best judgment. In addition to dependence on the human factor, a major defect of this arrangement lies in the uncontrolled excess air that enters through the fuel chutes. This makes impossible the close control of air-fuel ratio needed for high efficiency.

Automatic Feeding. The photo and diagram on the facing page show the automatic-feeding scheme developed at Klamath Falls to overcome these difficulties and boost combustion efficiency.



DRIVES AND CONTROLS placed in convenient location for cleaning and maintenance. Fuel-feed controllers stand alongside m-g sets, with the variable-speed motors above



SCHEMATIC DIAGRAM shows electrical connections for the variable-speed drives

An overhead flight conveyor brings wood refuse to the boiler room. A tapered hopper connects the conveyors overhead to a horizontal, tapered feed screw driven by a variable-speed dc motor. From the feeder trough the fuel flows by gravity to the furnace top, to drop on the pile in the dutch-oven cell. Combustion is completed in the main furnace of the 3-drum bent-tube 7000-sq-ft Erie City 3-pass boilers.

As shown in the diagram, air is drawn from above the furnace top, under the firing deck and up the boiler front to a warm-air duct. Fresh air, from within the boiler house and from the roof, flows alongside the stack uptake to the same warm-air duct, which supplies the forced-draft fan with slightly preheated air.

Much of the control hookup follows essentially conventional practice. The boiler-outlet damper is regulated directly from furnace pressure. A steam-pressure controller operates the forced-draft-fan outlet damper, the fan being driven by a constant-speed motor. A fuel-feed controller actuates the generator rheostat of the typical Westinghouse Ward-Leonard variable-speed-drive system diagrammed above. This arrangement regulates the speed of the dc feed-screw motor, controlling rate of adding fuel to the pile.

The fuel-feed controller is primarily responsive to a steam-flow controller. To compensate for differences in fuel conditions (relative amounts of sawdust, shavings and hogged fuel, percentage of moisture, etc) an additional secondary control to maintain desired air-fuel ratio seemed necessary.

Brilliancy Control. For this purpose, a photoelectric cell in the boiler furnace rear wall measures brilliancy of the flame and gas stream leaving the dutch-oven furnace and, through an averaging relay, works with the steam-flow controller to adjust fuel feed. With this arrangement, an increase in brilliancy shows an excess of air and a need for more fuel, while a decrease in brilliancy indicates need for cutting down fuel feed.

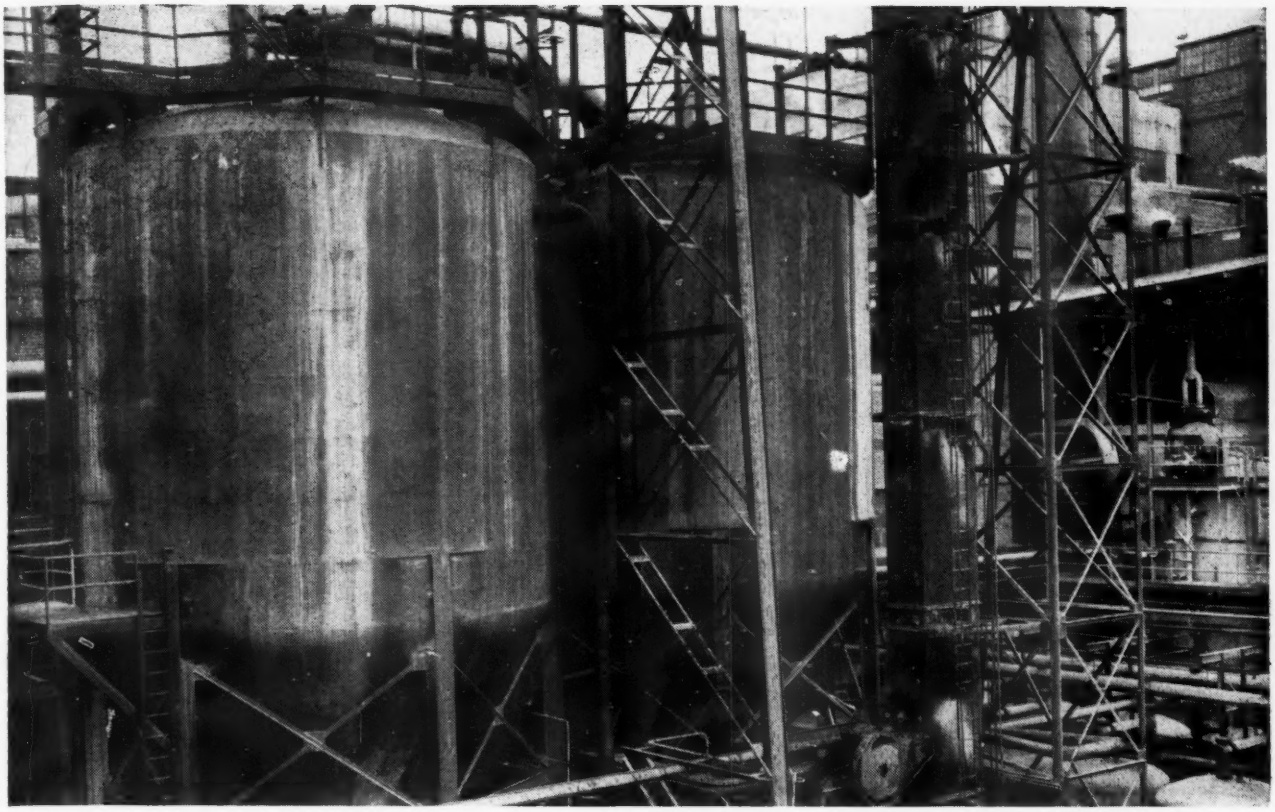
In normal operation, increased steam demand is reflected quickly in an increase in forced-draft air. As steam flow changes, fuel feed is increased proportionately, with the brilliancy controller acting to correct any change in air-fuel ratio and to maintain combustion at maximum efficiency.

Rate of fuel feed is indicated on a dial at each feed controller; draft gages, steamflow-airflow meters and other boiler instruments are grouped on a panel on the firing deck (see photos and diagrams). Selector valves on the panel permit switching from automatic to manual control as desired.

Hand orsat tests reveal that this control method automatically holds excess air within 2% plus or minus, at any rating from 20,000 to 60,000 lb of steam per hr. To do this, the brilliancy control regulates the height of the fuel pile on the grate, depending on the type of fuel being burned at any time, and maintains a clean fire, free from smoke. Gas analyses indicate approximately 22% excess air at high ratings and about 40% at low, with CO_2 at about 16-17% and no CO.

The steamflow-airflow meter was found to be an excellent operating index, correlating closely with the brilliancy values. For example, a deviation in excess air shown by the boiler meter also appears on the brilliancy-meter chart and is promptly corrected. When burning wet hogged fuel (approximately 55 to 65% moisture) the boiler meter shows about 10% lower steam flow than air flow because of the high loss represented by evaporation.

Successful Experience. Our experience indicates the brilliancy control to be of great help in compensating for varying fuel conditions and correcting the primary fuel-feed adjustment to maintain desired air-fuel ratio. The installation of automatic feeding, as a whole, has, in addition to conserving now-valuable wood-refuse fuel, made it easy to hold boiler output to desired levels. With hand firing the output could not be controlled closely and varied over a wide range.



1 First-stage is of sludge-blanket design. Second-stage phosphate unit is designed for lime-soda softening and silica reduction so it can be used when former is out for inspection. Phosphate treatment then goes to feed pump suction

Removal of Silica in a Sludge-Blanket Hot-Process Softener

By J D YODER, *vice-president, The Permutit Co;*
H Y CARBONNIER, *assistant technical director and*
A H MORRIS, *senior chemical engineer, Union Bag & Paper Corporation*

Two years' experience using sludge, which accumulates in hot-process lime-soda softener, to give longer contact between magnesium hydroxide and water, betters silica removal

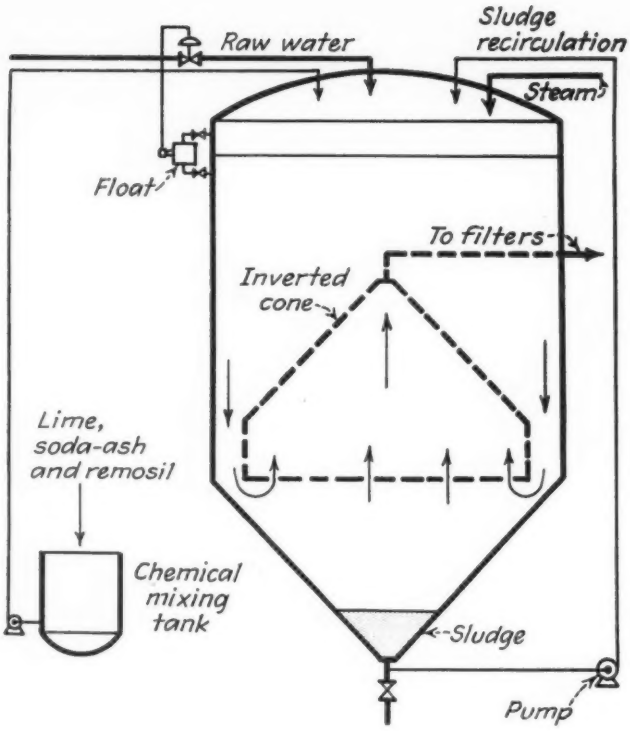
▶THE OUTSTANDING PROBLEM in the treatment of boiler water at the Savannah plant of the Union Bag & Paper Corporation has always been the removal of silica. The raw water, which is pumped from deep wells, has a silica content of approximately 55 ppm. In view of this problem, it was decided to install a new type of hot-process softener recently developed by The Permutit Company. A 72,000-gph softener of this type was installed and put into operation in November, 1945, Fig. 1.

MORE CAPACITY REQUIRED

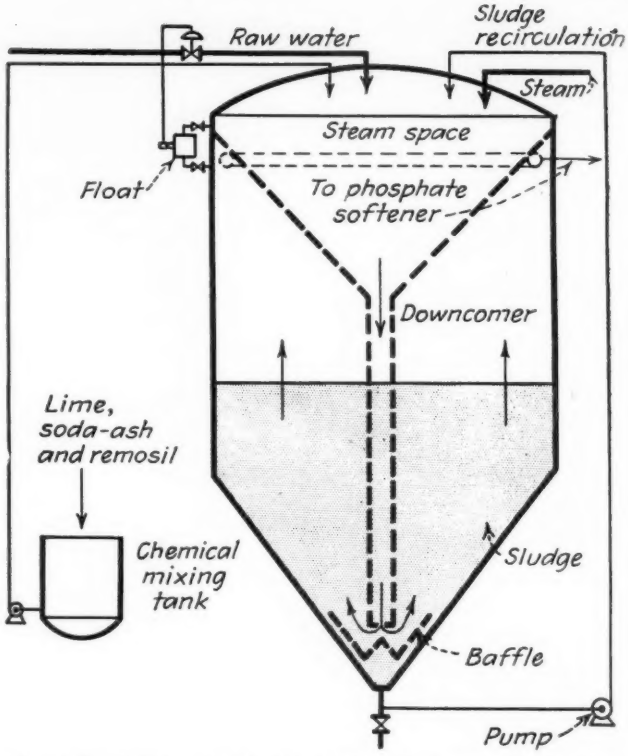
Prior to the installation of the new unit, makeup was treated by conventional hot lime-soda softeners. Nine years of operation with the old plant followed by two years of operation with the new plant have shown that the latter provides more efficient silica removal, as well as better hardness and turbidity reduction in the effluent.

Feedwater to the 430-psi boilers consists of 35 percent makeup, the remainder being condensate. The makeup was provided by one hot-process lime-soda softener of conventional design, Fig. 2, when the paper mill began operations. As the plant grew, similar units were installed until five with a total capacity of 52,000 gph were operating in parallel. Each softener had separate chemical-feeding equipment.

When increased feedwater demand called for still greater capacity, it was decided to install a 72,000-gph softener of the new sludge-blanket design. Although development of this type softener for silica removal was still in



2 In conventional lime-soda softener, water flows downward depositing its sludge, then leaves through inverted cone



3 Water entering sludge-blanket softener settles to bottom, and then must flow upward through the sludge to get out

the pilot-plant stage, it showed possibilities of providing much more efficient silica removal than a new softener of the conventional type. A second-stage tank of conventional design was installed for phosphate treatment. Provision was made for lime and soda softening and silica reduction in this softener, so that it might be used as a lime-soda softener while the primary unit is out of service for inspection. Piping was arranged so phosphate could be added at the feedwater pump section during such operation.

In the new softener, raw water and chemicals are sprayed into a collecting cone at the top, Fig. 3. The mixture passes through a downcomer to the bottom, where the water is deflected upward through a blanket of sludge. Clarified water is decanted to the phosphate softener.

SILICA-REMOVAL REACTION

Magnesium hydroxide, commonly used to remove silica from water, may be produced by precipitation of the magnesium salts in the water by calcium hydroxide. If there is insufficient magnesium in the raw water it may be added in the form of magnesium oxide or dolomitic lime. Activated magnesium oxide, especially prepared for the purpose, removes silica effectively. At this plant it was used in both types of softeners and was fed with high calcium lime and soda ash to meet our needs.

Removal of silica proceeds slowly, approaching a certain equilibrium point for each set of conditions. Several variables effect the speed and completeness of the reaction. The equilibrium point approached is determined by: (1) amount of silica in the raw water, (2) amount of magnesium oxide employed, (3) water pH, and (4) temperature in the softener. The speed of the silica-removal reaction varies with: (1) residual silica in the water, (2) concentration of magnesium hydroxide, (3) degree of unsaturation of the magnesium hydroxide, (4) water pH, and (5) temperature in the softener. As the silica is removed, con-

TABLE 1—Data Obtained from Softener Operation

Characteristics	*Conventional design**	*Sludge-blanket design***
Silica in raw water, as SiO_2, ppm	55	55
Silica in effluent, as SiO_2, ppm	11	2.0
MgO feed, ppm	76	50
Parts SiO_2, removed per part MgO	0.6	1.1
Avg retention time of $Mg(OH)_2$, hr	4.7	100
Contact time of water with $Mg(OH)_2$, min	92	87
Hardness of effluent, as $CaCO_3$, ppm	21	15
Average load on softener, % rated capacity	65	46
Temperature in softener	220 F	243 F

*Results based on operation during June-Oct, 1945.
**Results based on operation during July-Sept, 1947.

Table II—Typical Analysis Of Raw Water

Total hardness as $CaCO_3$	100 ppm
Calcium hardness as $CaCO_3$	60 ppm
Magnesium hardness as $CaCO_3$	40 ppm
Methyl-orange alkalinity as $CaCO_3$	110 ppm
Phenolphthalein alkalinity as $CaCO_3$	0 ppm
Silica as SiO_2	55 ppm
Chlorides as Cl_2	6 ppm
Sulphate as SO_4	12 ppm
pH	7.9
Temperature	74 F

tinued removal slows to such an extent that attainment of reaction equilibrium in the softener is not feasible.

PRELIMINARY WORK

Research at the Permutit laboratories and pilot plant demonstrated the value of a concentrated sludge bed for silica removal. Data taken from this work were used in preparing curves, Fig. 4, which show the amount of silica remaining in solution plotted against magnesium-oxide feed, both with and without a sludge blanket. The curves show that silica removal is much greater when the reaction is carried out in a concentrated blanket of sludge. Furthermore, in the region of low-silica concentration, relatively large increases in magnesium-oxide feed are necessary to achieve further reduction in silica, with or without the sludge blanket.

SILICA-REMOVAL COMPARISON

Although reaction equilibrium is not reached in the new softener, it is much more closely approached than in the conventional type. The greater efficiency of the sludge-blanket unit is attributed primarily to greater concentration of magnesium hydroxide with which the water comes in contact. Some increase in efficiency is due to higher operating temperature.

Table I provides a comparison of the two types of softeners over comparable periods, and shows the new unit's greater efficiency, silica removal per unit of magnesium hydroxide being about double.

In comparing operating efficiencies, it should be pointed out that during the periods considered the new softener was operated at a temperature approximately 23 F above that of the old units. Whereas extensive data regarding the effect of temperature on efficiency are not available, the results from operation for four days at lower temperatures indicate silica content of the effluent may increase by 1.5 ppm if the temperature in the new softener is dropped from 243 F to 220 F.

There was no significant difference in contact time of water with magnesium hydroxide in the two types of softeners. The contact time in the new unit could have been increased by raising the sludge level. This was unnecessary, however, because increasing the flow through the softener from 46 percent to 80 percent of rated capacity increased silica content of the effluent only one ppm.

All sludge was blown down from the old softeners once each eight hours, whereas only part of the sludge was blown down from the new unit once every two days. The average retention time of the magnesium hydroxide in the old softeners was 4.7 hours, compared to 100 hours in the new unit. Concentration of sludge in contact with the water in the old softeners averaged 1500 ppm; the added magnesium hydroxide was 23 percent of the sludge. Concentration of sludge in the new softener was 60,000 ppm of which 17 percent was added magnesium hydroxide.

Added magnesium hydroxide in the sludge layer was thirty times as concentrated as in the conventional softeners, although only 66 percent as much magnesium hydroxide was fed. As the speed of the silica-removal reaction is proportional to the concentration of magnesium hydroxide, and the contact time of the sludge with the water is the same in either case, it would be expected that more complete silica removal would occur in the new unit.

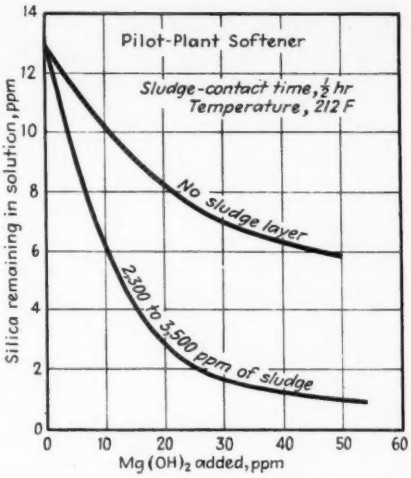
In the new softener, part of the unspent magnesium hydroxide settles out below the baffles at the bottom of the downcomer, requiring that sludge be recirculated from this area to obtain maximum efficiency. Rate of recirculation is not important; it may be stopped several hours without adversely affecting silica removal.

Recirculation of sludge in the old softeners caused the magnesium hydroxide to be re-used, and also increased the concentration of sludge in contact with the water from 480 ppm to 1500 ppm. The average retention time of the sludge was increased from 1.5 hours to 4.7 hours. Twice as much magnesium oxide was required when sludge was not recirculated; failure of sludge recirculation equipment consequently reduced silica removal.

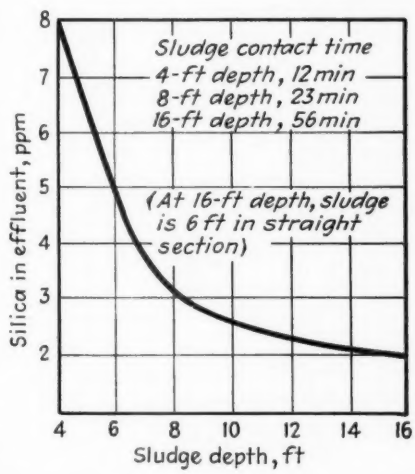
The amount of silica removed in the new softener increases with the depth of the sludge layer through which the water passes. During the operating period on which the figures in Table I are based, the sludge level was about 7 feet above the conical section. Raising the level above this point improves silica removal only slightly at normal load, Fig. 5.

EFFLUENT HARDNESS

Chemical feed to the new softener may be discontinued several hours without causing a dangerous increase in silica. This is due to the stabilizing effect of 4000 pounds of added magnesium hydroxide in the sludge layer. Failure of chemical feed to the old softeners, on the other hand, always caused a rapid and immediate increase in silica content.



4 Residual silica in the effluent with and without sludge-blanket action



5 Raising sludge level above 7 ft improves the silica removal only slightly

As shown in Table II, the raw-water hardness averaged 100 ppm. Hardness of the effluent from the new softener averaged 15 ppm as compared to 21 ppm from the old softeners. The lower hardness was due in part to the stabilizing effect of the undissolved calcium hydroxide in the sludge blanket, and in part to the lower solubility of calcium hydroxide at the higher operating temperature. Following stoppage of the chemical feed for two or three hours, treated-water hardness increased to only 25 to 30 ppm. This resulted in part from the 10 ppm excess sodium alkalinity of the raw water.

Although the percentage undissolved calcium hydroxide in the sludge of the old softeners was higher than in the sludge-blanket unit, the total

(*Continued on page* 156)

SPEAKING OF POWER

We can't help enjoying this characteristic bit of British understatement, from a paper dealing with the effects of atom bombs on naval vessels: "A further problem is presented by penetration into the living and working spaces of the ship of fission products drawn in by ventilator fans . . . or by convection . . . I need hardly add that at the present state of our knowledge *it is considered rather a bad thing to inhale fission products.*"

★ ★ ★

Every so often some one with pessimistic leanings casts a worried eye on records of silt deposits in Lake Mead behind Hoover Dam (Hoover to Boulder to Hoover—remember?) and predicts the near doom of that power development. In the original planning, Bureau of Reclamation engineers made an extremely conservative estimate, assuming that: (1) no sediment flowed out of the reservoir (2) none deposited above spillway level, and (3) no reservoirs were created upstream. On this basis, known to be too pessimistic, it was estimated that it would take 200 years to silt up Lake Mead. Many other estimates of Lake Mead's silting rate have been made, and while they differ widely because of uncertainty as to the weight to be given the various factors affecting silting, they agree that the development will have a long life. Furthermore, changes now occurring in the area, and those in prospect upstream, are all favorable to a lower silting rate.

★ ★ ★

Speaking before the New York Railroad Club, Gwilym A Price, Westinghouse president, revealed a 4-pronged attack on the problem of developing tomorrow's locomotives. Westinghouse is now: (1) working with B & W on an improved steam-turbine-electric locomotive, with a radically different high-pressure high-temperature boiler, hoped to reduce coal consumption by one-half (2) cooperating with Lima-Hamilton Corp on a free piston unit, using a power-gas generator under development for some time by Lima-Hamilton, and a Westinghouse 3000-hp gas turbine (3) building a gas turbine locomotive with two 2000-hp power units similar to the recently described experimental machine (POWER, Jan 1947, pp 98-102; March 1948, pp 80-82), and (4) planning for the Pennsy a new electric locomotive, half again as powerful as present largest units.

★ ★ ★

With radioactive materials now available from AEC at relatively low cost, "tracers" are being used in industry as they have been for the past decade in laboratory research. In what was probably the first full-scale investigation of this kind, Arthur D Little, Inc, recently determined for Republic Steel Corp that of the two forms of sulphur in coal—pyritic and organic—both carry over equally into coke. For the test, artificial pyrites were made from radioactive sulphur and mixed with 12 tons of coal, normal charge to a coke oven. The proportion of the coke's sulphur that came from the pyrites (the "tagged" compound) was found by measuring its radioactivity.

Radioactive sulphur for this study cost only $50. Such full-scale testing would have been prohibitively expensive before the war when that much radioactive material would have cost thousands of dollars.

Use of tracers to *control* industrial processes looks interesting also. For example, radioactive phosphorus added to a Bessemer converter would show when the last impurity, usually phosphorus, has been removed. Radiation-sensitive automatic controls would then turn down and shut off the Bessemer as desired. In spite of need for strict safety precautions in their use, radioactive tracers face a brilliant industrial future. What will be the first use in the power field?

★ ★ ★

Although there are as many predictions as there are experts, all agree that prospects for further tremendous expansion in power production, along with development of the synthetic fuels and chemicals industries, mean need for vastly increased coal output in years ahead, and greatly reduced mining costs. This is the background behind the coal industry's recent launching of an engineering program to develop a machine that will cut coal "off the solid" without use of explosives and load continuously into a conveyor or mine cars. Under direction of Bituminous Coal Research, the project has the support of 70 of the nation's leading coal producers, coal-land companies and railroads. Timetable calls for evolving a basic design for a practical machine in two years.

★ ★ ★

POWER's new sister publication *Operating Engineer*, has been gaining paid circulation at a phenomenal rate—more than 12,000 in less than 10 months. This naturally makes the editors feel good, but they got perhaps their biggest kick out of an inquiry from a power engineer in the British West Indies. He wanted to subscribe, he said, because he had run across a page of *OE* in the wrapping of a motor shipped from the U. S. It happened to be Phil Swain's editorial in the first issue, setting forth the plans for the new magazine. Our BWI friend said that was enough to show him that *OE* was the magazine he needed. Some thrifty manufacturer no doubt put his checking copy to one last use in shipping, inadvertently became *OE's* salesman.

★ ★ ★

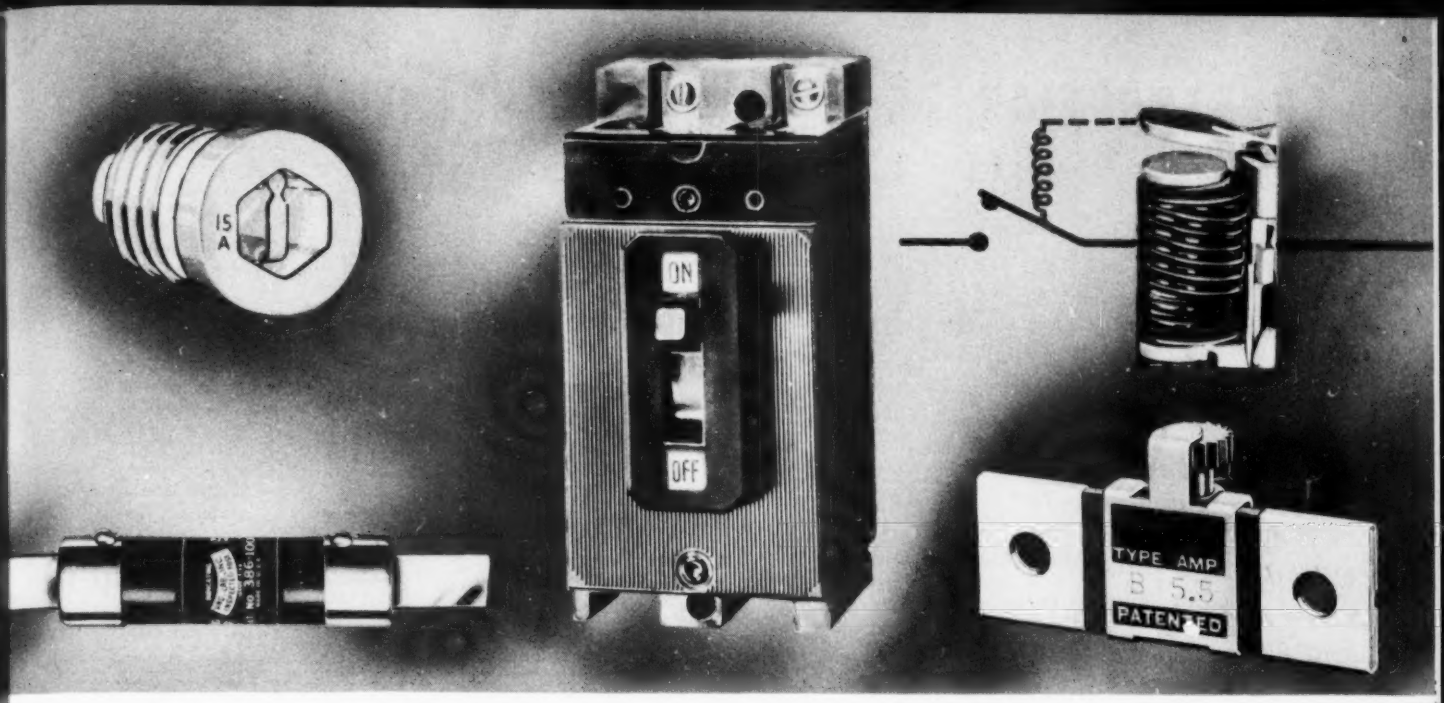
The Central Electricity Board of Great Britain has ordered another 15,000-kw gas turbine. This one, for Dunston power station of the North-Eastern Electricity Supply Co, will be built by C A Parsons and Co, Ltd. It has also been revealed that the 12,500-kw closed-cycle plant being built by John Brown and Co, Ltd, under Escher Wyss license, is to be installed by the North of Scotland Hydro-Electric Board and is expected to be running in 1950.

Metropolitan-Vickers Electrical Co announces it is building a 2000-kw gas-turbine set for standby service in its main works power station at Trafford Park, Manchester. It is an open-cycle unit, with regenerator.

THIS MONTH'S COVER

To dramatize low-voltage circuit protection, subject of a 16-page special section beginning on page 79 of this issue, McGraw-Hill photographer Syd Karson took the switchboard shot on POWER's cover. An operator is shown closing a panel-type circuit breaker feeding the dc bus.

Feeder breakers to either side of the operator are equipped with relays, which allow each circuit breaker to reclose automatically after tripping, provided the fault has cleared. Breakers shown are normally controlled from a remote point through a supervisory selector system.



CIRCUIT PROTECTION

By J J O'CONNOR, Assistant Editor

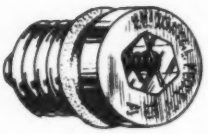
Every engineer recognizes that protective equipment is necessary to guard circuits and machines against abnormal conditions. Damaged equipment and extended interruption of production result from poor selection and improper maintenance of devices designed to guard electrical equipment and machinery. Since electrical protection is a form of insurance, an understanding of the operating principles as well as types of devices available is necessary for intelligent selection and use.

To aid in the understanding, selection and application of overcurrent protective devices used in low-voltage circuits, **POWER** has prepared this, its sixty-eighth, special section.

The needs of practical power engineers have been kept foremost in mind in writing the text as well as selecting illustrations. No attempt is made to cover all protective devices, discussion being restricted to overcurrent protection in circuits of 600 volts and below. This presentation divides into four parts: fuses, circuit breakers, thermal and magnetic devices, and applications. Since the power engineer is interested in good maintenance as well as design and selection, many practical field-tested hints are included to aid in troublefree operation.

POWER · July 1948 · P W Swain, Editor

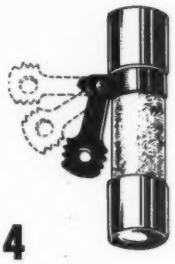
CONSTRUCTION FEATURES OF NONRENEWABLE FUSES



1 Plug fuses are used for branch-circuit protection. Maximum rating is 30 amp at 125 v. Time-lag type, shown at right, does not open on short-time overload

2 Indicator shows if fuse opens, making blown fuses easy to find. Not used on renewable type

3 Ferrule-end cartridge: 35-60 amp



4 Fuses are replaced safely by use of insulated grip. Conventional fuse puller is not needed

FUSES

A fuse serves as a safety valve in an electrical circuit, opening it when too much current flows. Unlike most other electrical protective devices, the same element detects flow of excessive current and interrupts the primary circuit. Simplicity, low first cost and application flexibility make fuses particularly suitable to protect low-voltage low-capacity circuits.

•

General Characteristics. Fuses consist essentially of two parts: (1) fusible element that carries current and melts when the current exceeds a definite value for a certain length of time (2) casing that encloses and supports the fusible element, or *link*, and makes contact with the external electrical circuit.

The original fuse was a thin piece of copper wire. This proved unsatisfactory since the element had to reach an extremely high temperature before it would blow. Copper soon gave way to alloyed wire with a lead base. As zinc has less tendency to hold an arc, it soon replaced lead.

All ordinary fuses have links of zinc alloy, with one or more reduced sections near the center. If an excessive current flows long enough, the link overheats and the thin portion melts. At first, the gap is not big enough to open the circuit and an arc forms. Further melting increases the gap to a length over which the arc cannot be maintained, and the circuit is then interrupted.

The two oscillograph traces, shown at *A* in Fig. 6, are of voltage and current taken at the point of short circuit. When the short was applied voltage dropped to a near-zero value while current increased to over 3000 amp. The fuse opened the circuit in 1/60 of a second. Oscillogram, *B* in Fig. 6, shows reignition of the arc, delaying circuit interruption. Here, increased capacity allowed short-circuit current to build up to 7580 amp. Time required to clear the circuit was twice that of *A*.

All fuses possess an *inverse time characteristic*. This means the amount of current flow that will blow the fuse decreases as the length of time over which it is applied increases. Fig. 7 shows a typical characteristic curve, illustrating the inverse-time principle. This curve represents the average blowing time of different makes and sizes of enclosed fuses of both the renewable and the nonrenewable types.

National Board of Fire Underwriters specifies that all fuses shall carry 110% of rated current indefinitely, and shall blow on 150% of rated current in a specified time. Fig. 8 shows time limits within which fuses of a given rating blow when carrying 150% rated current. For example, a 200-amp fuse opens in 6-12 min when carrying 300 amp. Since the ability of a fuse to dissipate heat increases with its size, because of increase in the conducting area, blowing time is greater for the larger fuse. Standard enclosed fuses must be capable of interrupting short-circuit currents of at least 10,000 amp at rated voltage. This test uses direct current. We may consider the maximum short-circuit current as that which would flow if the circuit were shorted at the point where fuses are to be installed.

Fuses are plainly marked to show current rating and voltage. Cartridge fuses in the 0- to 15-amp 250-v class have a blue label pasted on the fiber tube. If they are rated at more than 15 amp they carry a green label. All 600-v fuses have their current and voltage ratings printed on a red label.

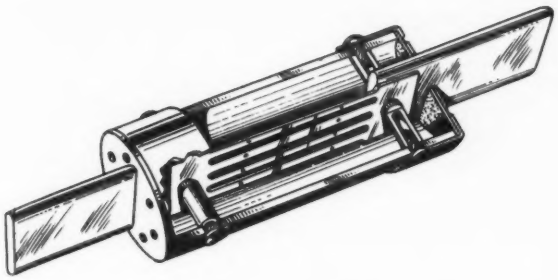
Fuses differ mainly in the form of casing. There are three basic types, each usually serving a definite voltage and current range: (1) plug fuses handle up to and including 30 amp at 125 v. (2) Cartridge fuses with ferrule end are rated up to and including 60 amp at 125, 250 and 600 v. (3) Knife-end cartridge fuses handle currents from 70 to 600 amp, at 125, 250 and 600 v. Over-all length of the 600-v cartridge fuse is greater than of those designed for 250-v circuits.

Plug Fuses. Plug fuses, Fig. 1, are limited to 125-v applications. They are commonly used on lighting circuits and for protection of small motors. A screw-shell base serves for both electrical contact and mechanical support. Fusible element is visible through a window of mica, glass or other transparent material in the cap.

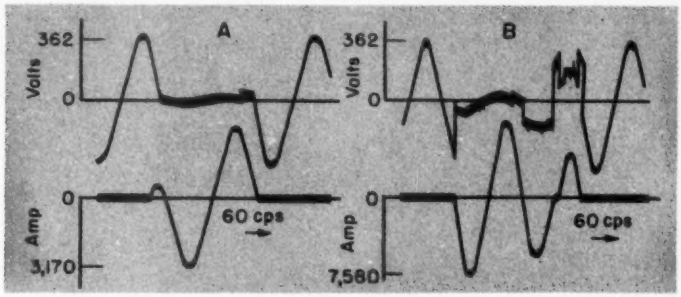
National Electrical Code requires that 0- to 15-amp plug fuses be distinguished from others of larger rating by a hexagonal window in the cap or some other prominent hexagonal feature. Plug fuses are available with a symbol on the transparent top indicating the link's condition. When it opens the symbol is destroyed, making it easy to pick out the blown fuse.

Both industry and the home make wide use of plug fuses. Misuse of units of this class is common. To prevent overfusing, bridging and

OPERATING TIME ON SHORT CIRCUIT AND OVERLOAD



5 Cartridge fuses having knife-end connections are rated 70-600 amp at 250 v. Similar construction is used in 600-v fuses but over-all length is greater



6 Oscillogram at A shows a successful circuit interruption under short circuit. Reignition of the arc is clearly indicated in B, delaying the circuit opening. Note voltage during period of short circuit

other abuses, the Type S nontamperable fuse has been developed. It can be installed in its own special fuse holder or any Edison-base fused-cutout by use of an adapter. Type S comes in two sizes: 0-15 and 16-30 amp.

Because of difference in base sizes, Type S fuses of one rating are not interchangeable with those of the other. The adapters are so made that once they are screwed into a standard-base fuse holder they cannot be removed. At the present time, use of Type S fuses is not mandatory although the National Board of Fire Underwriters has the matter under consideration.

Cartridge Fuses. In cartridge types, the link is enclosed in a hard-fiber tube. The element of nonrenewable fuses is surrounded with heat-resistant powder, which aids in quenching the arc by mechanically displacing it and cooling the metallic vapor. This vapor, produced by the fusible element under short circuit, generates considerable pressure on the cartridge. This is relieved and the gas cooled by vents in the cartridge ends. Typical links and cartridge constructions are shown.

When a fuse blows, only the link is destroyed. Fiber tube and copper ends remain intact. Development of the renewable fuse came as a natural outgrowth of the desire to retain these undamaged parts. Several renewable-link designs are shown in Fig. 13. Fig. 12 illustrates a renewable element that is encased in arc-quenching powder.

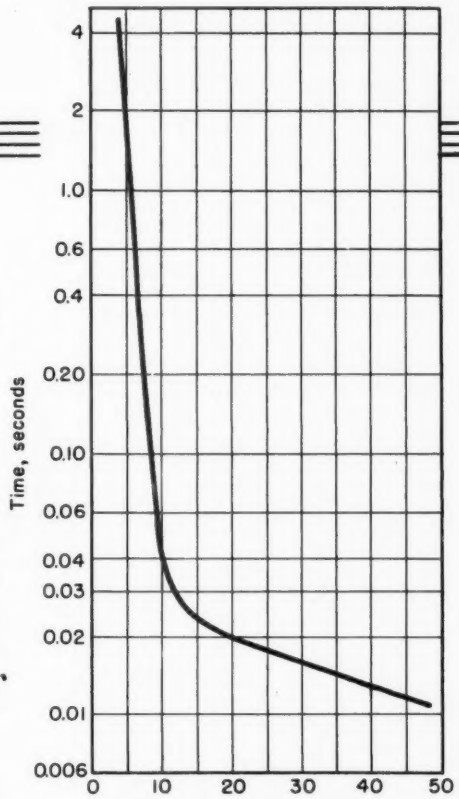
Nonrenewable fuses cost less and hence are widely used to protect circuits where faults are unlikely. Many of these fuses may be returned to the maker to refill at small cost. The renewable type represents a larger initial investment, but usually pays over an extended period since only the link is replaced each time the fuse blows.

•

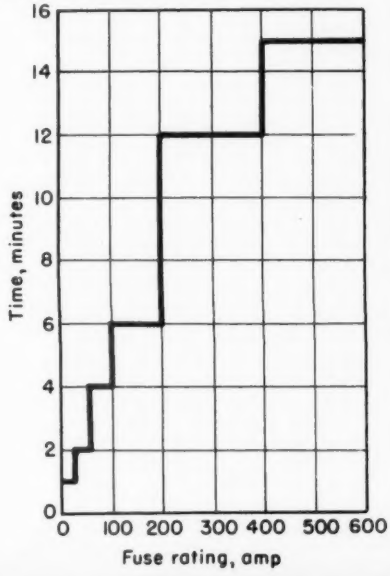
Time Lag. The time-lag fuse was developed to eliminate blowing on momentary overloads. On short circuit, it opens with the same speed as a regular fuse. Such a unit is well suited to protect motor circuits where the large starting currents would blow a regular fuse. This type is available in both the plug and cartridge designs for the standard voltage ranges. Fig. 13 illustrates the regular and time-lag renewable links.

In addition to those shown, another style time-lag fuse consists of a regular link in series with a thermal cutout. Fuse link opens on short circuit but will not blow on short-time overloads. Overloads that persist cause the thermal cutout to operate. This cutout is designed to trip under prolonged loads that are within 500% of the fuse rating. Copper link blows on overloads and short circuits drawing over 500% rated current. A helical spring is connected to the junction of fuse link and thermal cutout. On dangerous overloads solder in the cutout melts, allowing the spring to pull the fuse link and open circuit.

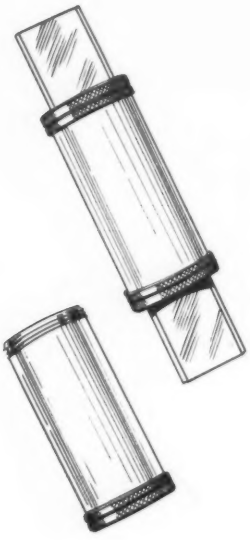
Panelboard overheating may often be traced to accumulated heat developed by fuses. It is reduced with time-lag fuses, which have lower resistance than ordinary units. Reduced resistance comes through the use of copper as the blowing element.

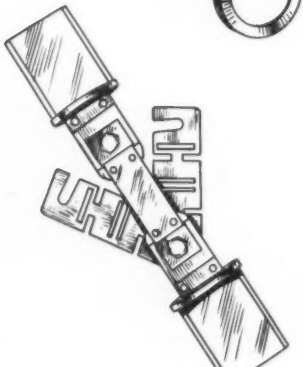


7-8 Typical blowing characteristic for various fuses is shown above. Opening time on 50% overload is shown below



TYPICAL RENEWABLE FUSES SHOWING CONSTRUCTION

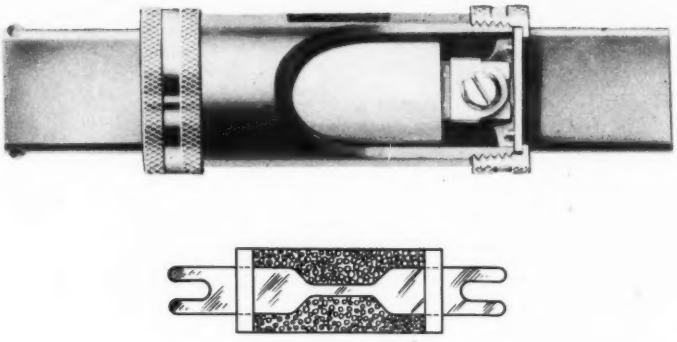




9 Fuse assembly showing element, cartridge case and end blades. Renewable element is held firm by washers and heavy bolts, reducing contact resistance to a minimum

10 Extra time-lag is provided by lag plates. Narrow sections of the link are kept from opening under momentary overload by the thermal capacity of plates

11 Series of thin sections decreases interrupting time of fuse. Short-circuit current results in series of arcs that quickly go out



12 Asbestos powder surrounding the renewable link aids in quenching the arc. Blade-end cartridge fuse shown is in the 70-600 amp, 250-v class. Most renewable elements are type in Fig. 13

In replacing ordinary fuses with time-lags, the size often has to be reduced. This is important in motor protection since overfusing with time-lags reduces motor overload protection. Size reduction may be made without changing the original fuse holder. Reducers are available that fit into knife clips if it is necessary to change to ferrule-end fuses.

Renewable Time-Lag Link. The renewable link, at the far right in Fig. 13, consists of a series of narrow- and wide-element sections. Wide portions are called the thermal areas and act as heat-storage compartments. Under short-time overloads, these sections absorb the sudden heat from surrounding thin spots. Thus the fuse is prevented from blowing on momentary overloads. Should over-current continue, the heat-absorbing capacity of the thermal areas decreases, allowing reduced sections to melt.

On short circuit, thin blowing areas open since time does not permit heat dissipation to thermal sections. Large link-end connections provide points of heat dissipation through copper-fuse terminals besides assuring minimum contact resistance.

Time-lag link in Fig. 10 provides an extra degree of time delay. Two heavy lag plates separate three thin blowing sections. Heavy portions provide time lag by drawing heat from the adjoining thin spots. Principal blowing parts are the two thin sections, near the terminals, which open on short circuit. Since two arcs in series cannot be maintained at the same voltage as easily as one, fast interruption results. Hence less metal is vaporized, reducing pressure developed within the fuse. Because of this condition, there is less possibility of the fuse exploding or belching fire on short circuit. On gradual temperature rise, due to prolonged overload, the lag plates cannot absorb the extra heat and so the reduced center section opens.

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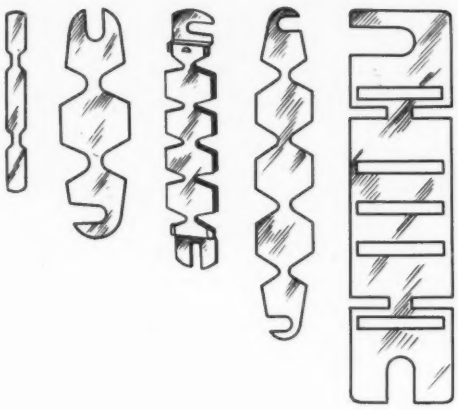
Why Fuses Blow. A blown fuse indicates trouble in a circuit. There are several reasons for blowing in addition to a short circuit and overload. Poor electrical contact at the fuse holder causes overheating, which lowers the fuse's current rating. Discoloration of the copper results, making this trouble easy to spot.

Fuses are often used in motor circuits for short-circuit protection, while a thermal device connected in series with the line operates if motor is overloaded. Here fuse rating is well above full-load current rating of motor to allow for heavy starting currents. If fuses are used for overload as well as short-circuit protection, select the time-lag type to prevent blowing on motor starting.

If a fuse is at a point where ambient temperature is high, it cannot carry its rated load. Since temperature changes affect fuse operation, they should be installed when possible where the fuse is

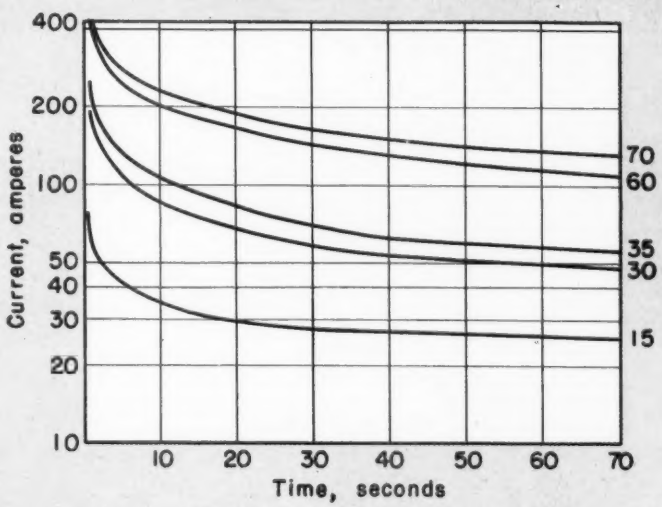
AND LINK DESIGN



13 Renewable links commonly used are shown. The time-lag element to right has blowing areas along the edge. Center area provides time-lag

14 Good clip contact reduces fuse heat. Clamps compensate for lack of tension

15 Clamp holding ferrule clip snug is easily removed for fuse replacement by unscrewing the cap



16 Typical time-lag characteristic curves for several renewable links, showing high lag at start

subject to the same ambient temperature as the protected equipment. Observe this precaution generally in applying protective devices that operate on the thermal principle.

Overfusing. Overfusing is not the proper remedy for annoying circuit interruptions. Where fuse blowing is frequent due to overloads, the blowing prevents motor or wiring burnout. Too large a fuse reduces the degree of protection against overload and defeats the purpose of fusing.

Drilling holes in the sides of fuse cartridges, to cool the element, is a dangerous practice. On short circuit a high pressure is developed within the fuse that aids in quenching the arc. Small vents at each end of the cartridge relieve pressure after it has swept the arc. Holes in the tube reduce pressure, lowering rupturing capacity of the fuse. They also allow emission of hot gas and molten metal, both of which are hazardous.

Good Contact. Importance of good electrical contact at fuse clips cannot be overstressed. Keep in mind that a fuse blows when heat developed exceeds the element's melting point. Since total current passes through the fuse clips, any resistance at those points causes additional heat to be generated. As a result, the fuse blows below its rated current value.

Poor contact at fuse ends reduces spring tension of clips due to the heat developed. Tension loss introduces additional resistance, further increasing the heat. To insure good fuse contact, terminal clamps, Fig. **14 and 15, may be used. Replace any** spring clips that may have lost their tension.

It is good practice to check fuse holders periodically, keeping the above points in mind. Fuses in critical circuits, which normally carry near rated current, should be replaced at regular intervals. At time of replacement, check fuse clips for tension. Fuses taken out of service may be returned to stock after inspection.

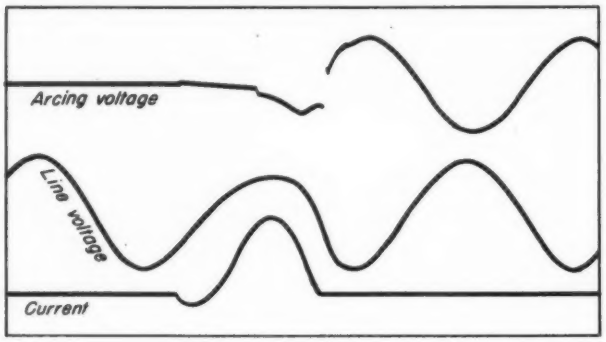
Fuses in Parallel. Fuses are ordinarily made with current ratings up to 600 amp. Those of higher rating are made on order. To protect circuits carrying more than 600 amp, fuses in the standard range are often paralleled. When so arranged, any additional resistance introduced in one fuse path results in the other fuse carrying a proportionately greater current. If fuses in parallel blow frequently, the cause may often be traced to poor contact at one fuse clip. Increased resistance at this point reduces current flow through that fuse; the fuse in parallel blows since it assumes a major portion of the circuit load. Current then shifts back to the first fuse, causing it to open on overload.

Where practicable, avoid paralleling of fuses.

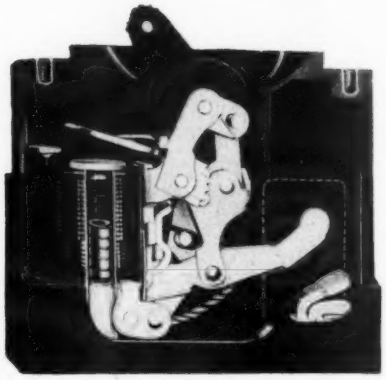
On parallel installations, it is good practice to measure the current through each fuse periodically. A split-core ammeter serves this purpose in an alternating-current system. An appreciable unbalance should be corrected.

Renewable Links. Note these precautions in connection with renewable links: (1) After repeated blowing there is a tendency to end the annoyance by using two links in parallel or a link of higher current rating. This merely removes the symptom temporarily while cause of failure remains. (2) Renewable link often overheats and blows because of poor element contact at either end. When renewing, be sure element and link terminal are clean before screwing on end caps.

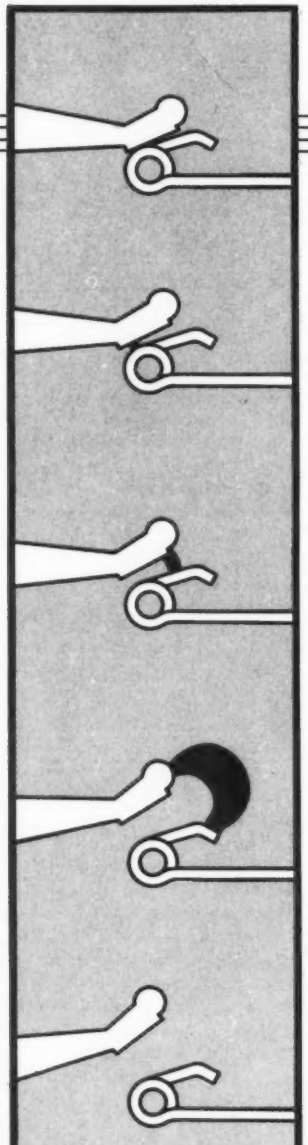
SEVERAL METHODS USED IN CIRCUIT BREAKERS TO



1 Oscillogram shows interruption within ½ cycle of 6450-amp short circuit. Breaker rated 50 amp, 120 v



3 Stationary contact coils around insulated iron core that connects steel plates (one shown) to form a U-shaped blowout coil



2 Many breakers use plain break shown above to interrupt the current flow. Contacts usually are silver since the silver oxide that forms on the contact surface is a good electrical conductor. Speed in opening breaker reduces contact pitting

CIRCUIT

The circuit breaker is a device designed to interrupt abnormal current flow in a circuit. It differs from the fuse in that it requires two parts to: (1) detect excessive current and (2) open the main circuit. Here we will discuss principles of circuit interruption as well as types of interrupters.

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Circuit-Breaker Principles. The circuit breaker usually serves a dual function, acting both as switch and overcurrent device. When the breaker trips no replacement of parts is necessary, as it is with a fuse, so time and cost of circuit interruption are reduced.

Formerly circuit breakers were used mainly in high-current circuits (over 600 amp). Of late they have also found wide application in the low-current field. The majority of such breakers have a fault-detecting element that operates on the thermal principle. Many others combine a thermal and magnetic element for more selective operation, Fig. 11. The magnetic principle alone as a fault detector is used in a limited number of circuit breakers in the low-current class, Fig. 3. Construction and characteristics of thermal and magnetic detectors will be described later. When most low-current circuit breakers trip on overload, the operating toggle goes to mid-position. To reset, simply return the toggle to "off" position then snap to "on".

Fig. 10 and 12 show circuit breakers in the high-current class. **Their fault-detector usually is magnetic. This type may be operated** from a remote point. Where time of circuit interruption must be reduced to a minimum, a reclosing relay allows the breaker to close as soon as the fault is cleared.

Circuit breakers are available with time lag to provide for starting surges, as in Fig. 7. As in motor starting, large surge currents flow when incandescent loads are applied. Fig. 6 shows the momentary current that flows when a cold filament load is applied to a circuit. Note the initial surge current due to the low resistance of the cold lamp filaments. As the lamps heat, resistance of the filaments increases, reducing within a **few cycles the current flowing** in the circuit. Fig. 7 also shows variation of the circuit breaker tripping characteristic with time, when used with an incandescent load. As current decreases, the tripping point of the circuit breaker is lowered, assuring full circuit protection.

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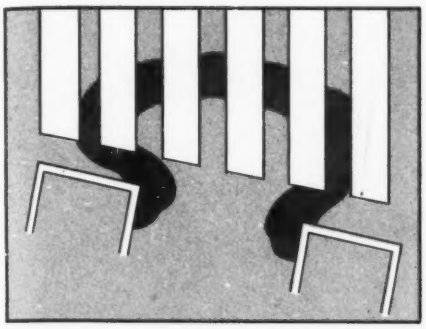
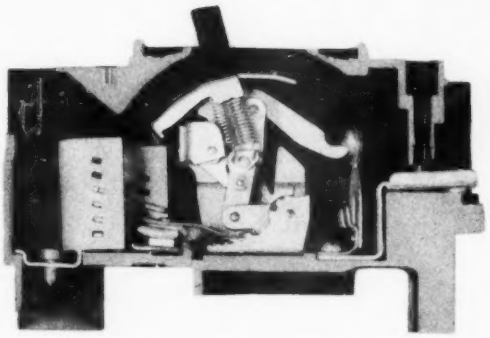
Interrupting the Arc. A circuit breaker must break the primary circuit and also extinguish the arc that forms between the contact surfaces when the breaker opens. Below, we outline the fundamentals of circuit interruption using an air breaker, in addition to a few common methods of breaking the arc.

Direct Current. To interrupt dc successfully, the circuit breaker must open to a point where voltage required to maintain an arc is greater than that existing between the open contacts. Consider the load's nature when selecting circuit breakers for dc systems.

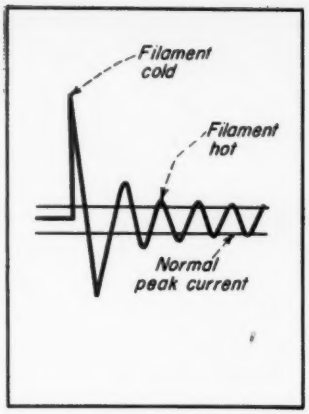
INTERRUPT FLOW OF FAULT CURRENT



4 Deion arc quencher has a series of metal plates which break up the arc



5 Life of breaker contacts is increased through use of the deion arc chamber



6 Incandescent load draws a heavy current momentarily

BREAKERS

Incandescent and resistive loads may be interrupted with relative ease. Heavy arcing occurs when a series motor circuit is opened because of the magnetic effect of the series field. The collapsing magnetic field induces a voltage within the series field windings, which in turn tries to maintain current in the circuit during the period of circuit-breaker opening.

Alternating Current. Let's consider the ideal case if an ac circuit breaker interrupts a unity power factor or resistor load. Since current and voltage are in phase, the arc is interrupted when the voltage reaches its zero value. A sufficient gap must exist between the contacts at that time to prevent re-establishment of the arc when voltage increases in the next cycle.

Interrupting a reactive or motor load presents a greater problem since voltage and current are out of phase. Current continues to flow during the time voltage passes through its zero value. When current decreases to zero, a voltage exists between the open contacts, resulting in re-establishing the arc. The time necessary to interrupt a reactive load depends mainly on the speed at which the contacts separate the necessary distance to prevent restarting the arc.

Short Circuit. A short circuit at any point in a system causes an abnormal current to flow. The value of this fault current in an ac circuit depends upon the sub-transient reactance of the rotating machines connected to the system at the time, and the impedance of the circuit between the source and point where short circuit occurs.

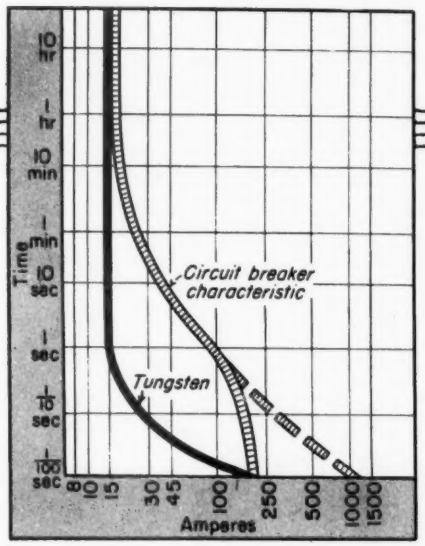
All synchronous generators, synchronous motors and induction motors are sources of short-circuit current. They contribute an initial heavy current surge that diminishes rapidly, Fig. 9. This is a typical curve of a short-circuit current in one phase of a low-voltage 3-phase system. The curve *AB* represents the dc component that displaces the total current wave from the horizontal zero axis. After a few cycles this dc component of current dies down and leaves only the ac component, which is symmetrical to the zero axis.

Since the maximum interrupting duty of low voltage air circuit breakers is assumed to occur one-half cycle (60-cycle basis) after the fault occurs, effect of the dc component on the short-circuit current is considered in design of circuit breakers for high-current applications.

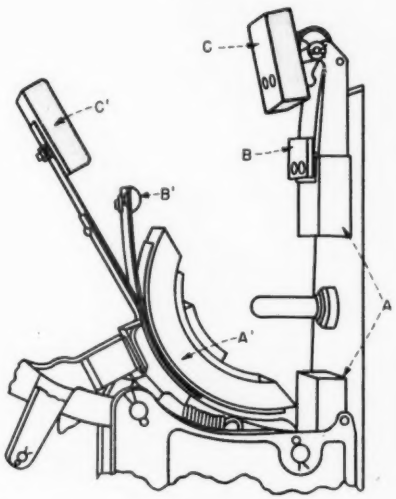
Plain Break. The smaller circuit breaker, often uses a simple break arrangement to interrupt the primary circuit. Successive steps in interrupting current flow are illustrated in Fig. 2.

When circuit breaker contacts open in air, an oxide of the contact metal is formed on the contact surfaces, after an electrical arc is established. Silver contacts are generally used since silver oxide is a good electrical conductor.

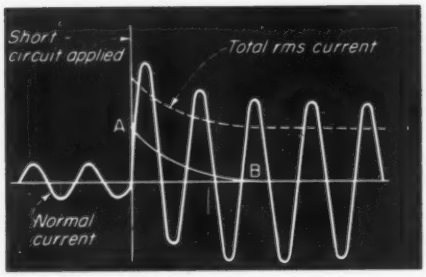
Deion Principle. For an arc to exist, the gas between open contacts must be in a conducting state. When the electric-current flow is interrupted between two surfaces, air between the contacts becomes ionized, making it an electrical



7 Circuit breakers with initial time lag will not trip on incandescent surge

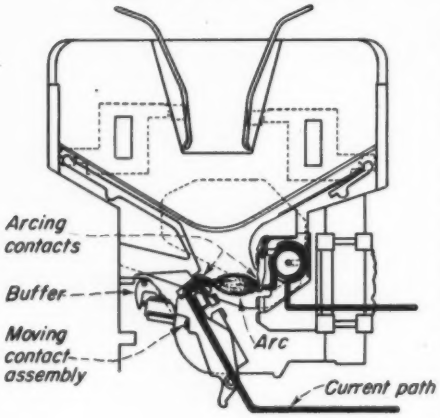


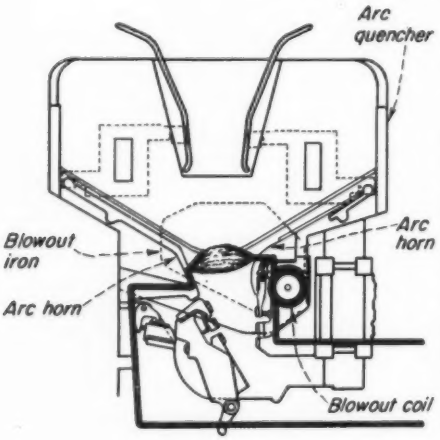
8 When breaker trips the main contacts shift load to contacts B'B. These in turn should open before arc is broken by carbon tips C'C. Carbon was used to break arc because of its non-pitting characteristic. Most manufacturers now use a silver alloy in place of carbon

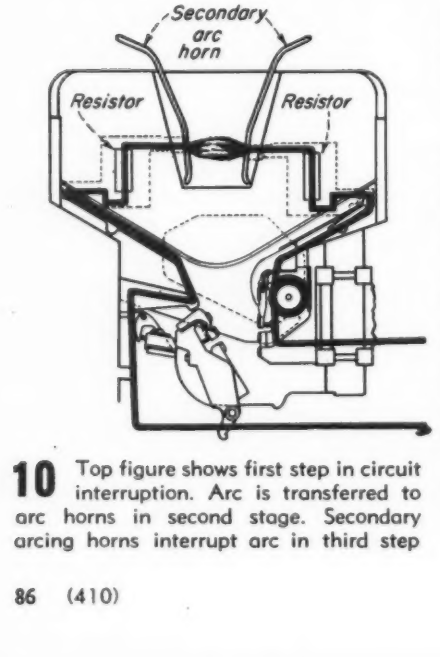


9 Oscillogram of short-circuit current showing direct current component AB

HIGH-SPEED BREAKER







10 Top figure shows first step in circuit interruption. Arc is transferred to arc horns in second stage. Secondary arcing horns interrupt arc in third step

conductor. It is ionized when electrically charged particles (ions) are formed. If they lose their charge the air becomes deionized and its conducting ability is destroyed. This results in the arc going out.

Deion feature is shown in Fig. 4 and 5. A series of slotted steel plates are mounted between supports of insulating material. As the breaker opens, the moving contact passes through the slots in these plates. The arc formed generates a magnetic flux in the plates. This flux drives the arc into the grids, cutting it into a series of short pieces. Each small segment forms a cathode and anode layer resulting in decreased conductivity of each arc section. This process, deionization, results in extinguishing of the arc.

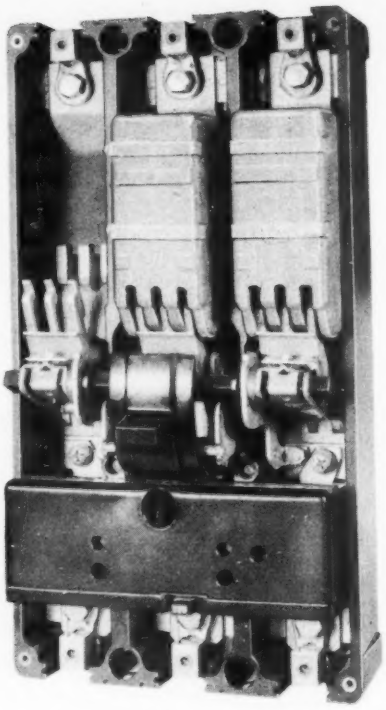
Magnetic Blowout. Length of time that an arc exists between open circuit-breaker contacts is greatly reduced by the magnetic blowout coil. Fig. 13 shows how the magnetic blowout coil fits into the contact structure of a circuit breaker. Coil is connected in series with the main circuit.

Effect of the blowout coil is to pull the arc away from the contacts, up into the arc chute where it is cooled and quenched. Rapid arc interruption is desirable both for quickly deenergizing the circuit as well as reducing contact pitting.

An analogy may be drawn between the blowout-coil effect and the action of a magnetic field on a conductor-carrying current. Let's apply the principle involved in motor action directly to the blowout coil. A force that tends to produce motion acts on any current-carrying conductor placed in a magnetic field. If we replace the conductor with an ionized gas (the arc) the resulting force tends to move the arc. It is the combined effect of this force and the pressure developed within the gas that pushes the arc away from the contacts up into the arc chute. Cooling action of the chute, in addition to the increased length of the arc, results in fast interruption of the arc.

Panel Breaker. To prevent pitting main contacts, many panel breakers now in use have a carbon contact in parallel, Fig. 8. Most manufacturers have discontinued the carbon breaker since it has been found the relatively high resistance of carbon resulted in the arc being broken by the secondary contacts. Typical contact structures available are shown in Fig. 12 and 13. Main contacts are of silver alloy blocks, electrically brazed to copper bars. Arcing contacts, which protect the main contacts, are made of heat-resistant silver alloy welded to solid copper.

Arc Horns. The high-speed air



11 Air circuit breaker rated 225 amp. Note multislot contact construction

breaker was developed to interrupt large direct currents in a few thousandths of a second. Fig. 10 shows various steps in breaking the arc with a high-speed breaker. When the main contacts separate, the arc is drawn between the arcing contacts with the blowout coil in the circuit. In the second stage of interruption, the arc is transferred to the arc horns, shifting it away from the main contacts. Lower diagram shows the final stage in circuit interruption. Arc is now between the secondary arc horns, a resistor has been introduced in the current's path to limit its value before breaking the arc.

High-speed breakers are used widely in dc systems employing synchronous converters, to protect against flashover.

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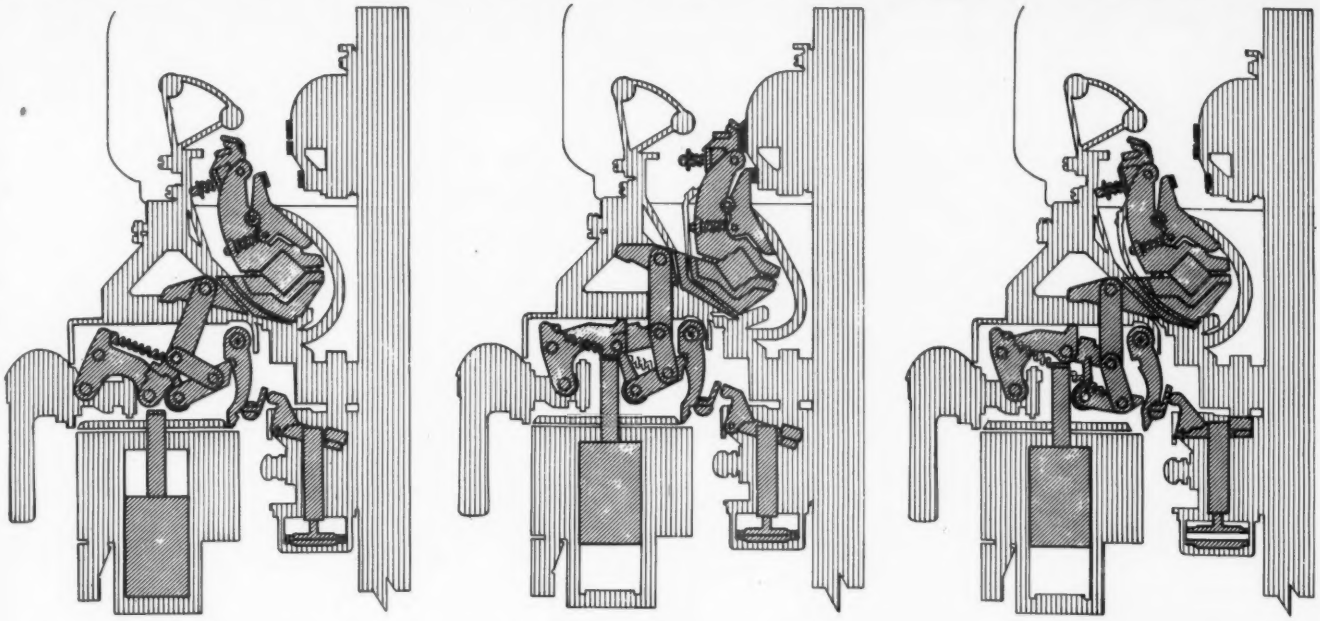
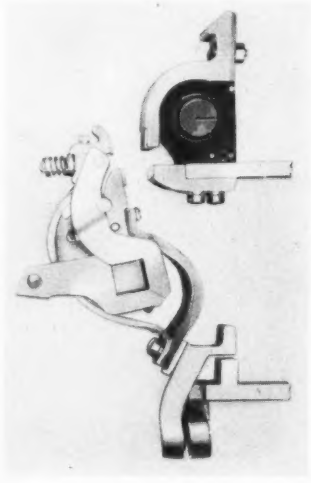
Breaker Operation. Majority of circuit breakers in the low-current class (to 600 amp) are closed manually. Higher currents are usually handled by breakers, as in Fig. 10 and 12. This style breaker may be closed and tripped by hand but normal operation uses auxiliary devices, such as a solenoid to close and a trip coil to open.

Solenoid Closing. Fig. 12 shows steps in closing a panel-mounted breaker. A solenoid closes it. As in step 2, the closing coil, when energized, forces the operating plunger against the closing toggle. This unit in turn transmits the closing force through a linkage that closes the breaker contacts.

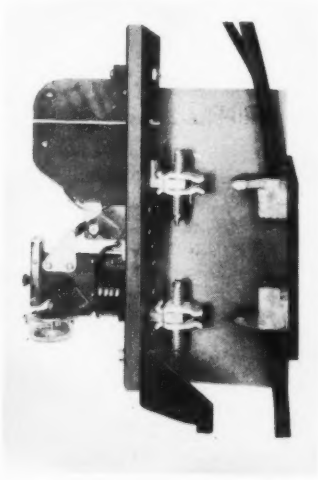
PANEL-MOUNTED BREAKERS: TRIP-FREE PRINCIPLE



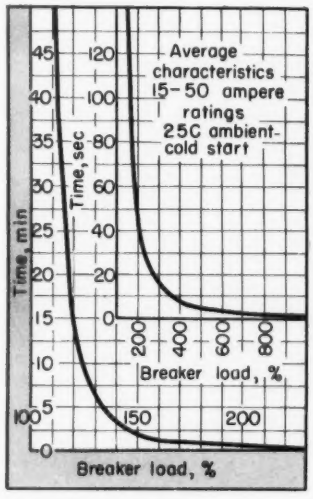
12 Steps in closing a trip-free breaker on a short circuit. Illustration to left shows breaker open with both trip and closing coils deenergized. Closing plunger is raised in center panel, closing breaker. When main contacts touch, the trip coil operates tripping toggle, as shown in right panel. Breaker trips even though closing plunger is in up position



13 Core of magnetic blowout coil shown at top contacts



14 Side view showing disconnecting stab contacts of drawout circuit breaker. Complete unit removable for maintenance



15 Tripping characteristic of thermal-trip breaker

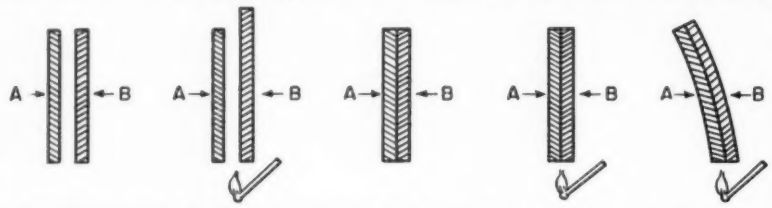
The breaker is opened through a mechanical trip-latch arrangement operated by a trip coil. This is often energized by an overload relay which detects the fault current in the primary circuit. The breaker may also be tripped from a remote point by energizing the trip coil through a hand switch on the control board.

Many dc panel breakers have a tripping device, which consists of a laminated iron horseshoe frame fitting snugly around a section of the stationary contact structure. The magnetic frame is insulated from the primary circuit. One section of the frame is hinged and connected to the trip latch of the breaker. When an overload occurs in the primary circuit, the hinged arm is pulled by magnetic action tripping the breaker.

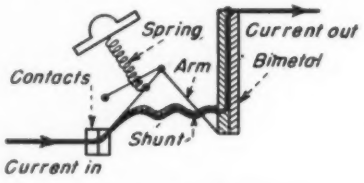
Trip Free. Fig. 12 illustrates a circuit breaker's *trip-free* action. This term means the circuit breaker cannot be held closed on an overload. Upon attempting to close such a circuit breaker by hand, against an existing short circuit or overload, it closes to the point where the arcing contacts meet. The large fault current causes the tripping mechanism to open the breaker, before the main contacts are latched closed. This automatic feature prevents damage to the circuit breaker as well as the circuit.

Motor Operated. A motor-operated system of linkages closes the high-speed breaker in Fig. 10. Once the breaker is closed it is held in that position by a holding coil. The breaker is tripped by opening the coil circuit. This is usually done by an auxiliary contactor which has been energized by an overload device located in the main circuit.

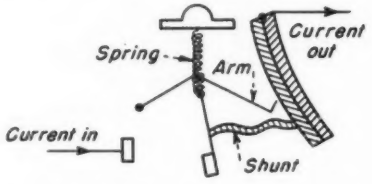
HOW THERMAL ELEMENTS WORK



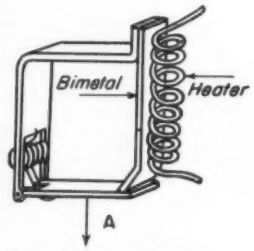
1 Bimetallic principle is illustrated above. Two metals with unequal coefficients of expansion, A and B, are welded. When heat is applied the combination strip will bend, operating a circuit-opening mechanism



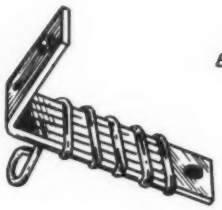
2 Heat to the bimetallic strip is generally supplied by a coil connected in series with the load.



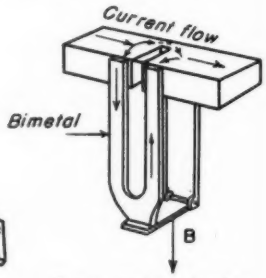
Time required to operate decreases as load increases. Strip returns to normal position after it has cooled



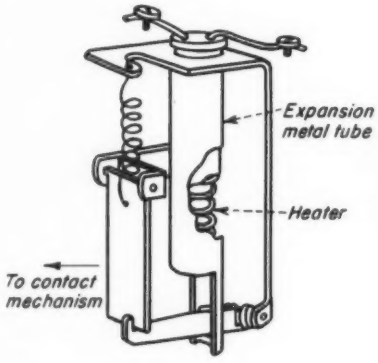
3 When bimetal strip bends, trip latch moves up and operates mechanism that opens contacts in load line



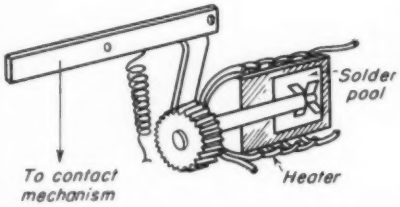
4 Heaters used with bimetallic element can be replaced with one of different rating if load changes



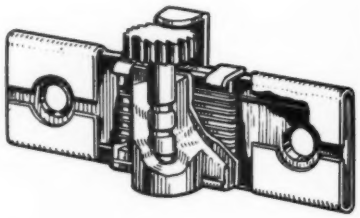
5 Part of current to load passes through bimetal element. Heat generated by overload current deflects strip



6 Heater is inserted in manganese alloy tube. When connected motor draws overcurrent, heat developed within tube causes it to expand. A lever mechanism trips relay



7 Heat developed within coil melts solder allowing ratchet to trip. Can reset relay after solder cools



8 Cutaway view of alloy-pool type relay showing heating grid and alloy pool. Ratchet wheel engages a spring-held tripping mechanism

THERMAL

Protecting a circuit against overcurrent consists essentially in providing (1) a device to detect flow of excess current and (2) a means of interrupting the circuit. Methods commonly used in opening the circuit were discussed in the last few pages under the heading, "Circuit Breakers." We will now take up fundamental principles in detecting excess current, as well as typical overcurrent detectors.

•

Thermal Devices. Flow of current through a resistor generates heat, the value of which varies as the square of the current flowing. For a motor, the maximum current that can be safely drawn, and hence the greatest output the unit can deliver, is limited by the temperature rise within its winding. The thermal overload device was developed to permit short-time overload, while still protecting against overload that would injure the insulation of the motor's winding.

The thermal relay consists essentially of three parts: a *heat-producing* means, a *heat-responsive* device, and a *contact mechanism*. Generally speaking, thermal relays may be divided into two classifications according to the type of heat-responsive device: *bimetallic* and *solder pool*. Several forms are illustrated in the panel to the left. The heat-producing means is generally a heater coil. Thermal devices are connected in series with the load; hence the current flowing, which produces heat within the motor's windings, will generate a proportional amount of heat within the thermal device.

Referring to Fig. 1, we see illustrated the fundamental principle in the operation of a bimetallic strip. Metals with a different coefficient of expansion are bonded together. When heat is applied, each strip will expand at unequal rates, resulting in a bending action of the whole. The heat is supplied to the bimetallic strip by a heater coil, which surrounds the element and is connected in series with the load. The bimetal thermal relay is widely used today.

The solder-pool type of thermal protector is illustrated in Fig. 7. This relay consists of a container filled with a specific amount of solder. As with the bimetallic strip, a heater surrounds the cylinder holding the solder. A ratchet arm is connected to radial vanes in the solder pool. The device is so calibrated that upon

flow of excess current sufficient heat is generated within the coil to melt the solder. The vanes are now free to turn, and since they are under spring tension the ratchet arm will move. This movement operates a tripping mechanism that opens the circuit.

Fig. 6 illustrates the expansion-tube thermal relay. The element that responds to temperature in this relay is a manganese-alloy tube. A heater is inserted in the tube supplying sufficient heat on overcurrent to cause elongation of the tube. This movement releases a latch mechanism, which in turn operates the relay contact. As the movement of the alloy tube is very small, a large multiplication of lever ratios in the latch mechanism must be used. It is essential in this type relay that all parts be held to close tolerance.

The relay shown in Fig. 15 uses the heating effect created by a current induced in a copper tube. As in previous relays, the coil is connected in series with the load. A copper tube is inserted in the coil and through transformer action, current is induced within the tube, generating heat. This heat in turn is transferred to a solder-ratchet relay. Since the heat generated depends upon transformer action, this relay is used in alternating-current circuits only.

Thermal relays are most commonly used to protect motors against overload. They are particularly suited for this application because they not only have time-lag characteristics, but, in addition, thermal relays are available which act to sum up the heating effect of a series of minor overloads.

To illustrate this point, let us consider the action of the thermal-overload device connected to a motor which is subjected to periodic overloads. Each period of overload contributes to the temperature rise within the motor. Hence, it is easy to understand how a motor could be damaged if subjected to a sufficient number of these short-time overloads. Since the thermal device operates on the temperature-rise principle, each period of motor overload will act to raise the temperature of the thermal relay. In this instance, although each short-time overload did not draw sufficient current to operate the relay, the device will, nevertheless, operate before the resulting temperature of the motor winding reaches a dangerous limit.

Most thermal relays may be designed to reset manually or automatically. Automatic reset may be an advantage if the relay is some distance from the connected motor, and the motor is subjected to few overloads. It is good practice to use manually reset thermal relays to reduce motor overloading by the machine operator.

A combination starting switch and thermal-overload relay is shown in Fig. 11. The device is well suited to operate and protect small motors. A thermal device incorporated in the switch consists of a small heater coil connected in the motor circuit. The coil surrounds a steel ratchet fastened to a fixed shaft. A solder-pool device operates the ratchet arm. Fig. 12 shows overload relay with melting alloy element in place. Overcurrent of sufficient duration allows ratchet of element to turn opening circuit. Pressing button resets relay after cooling.

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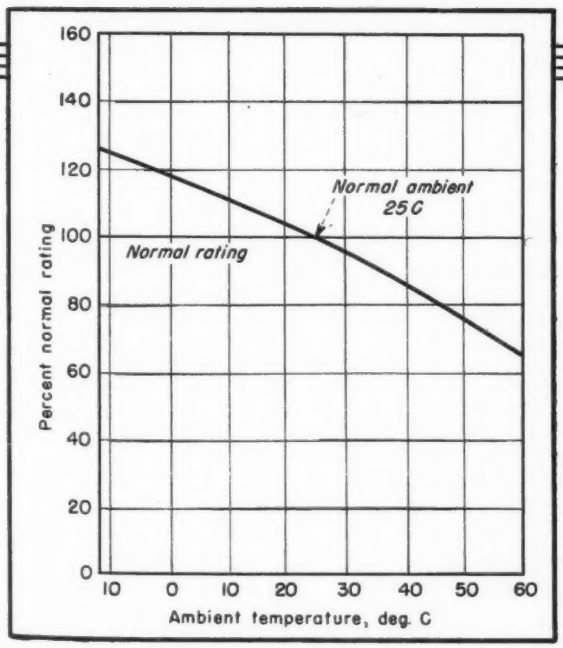
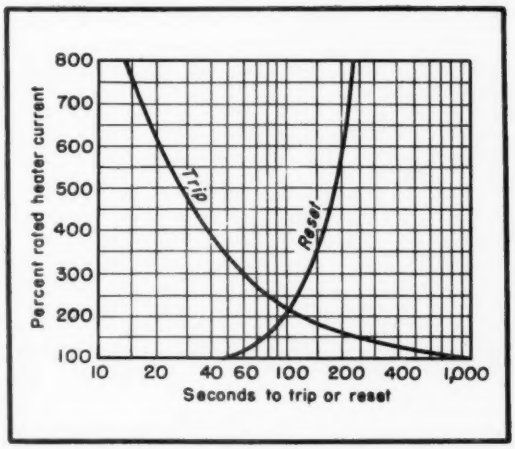
Thermostatic Protection. Another type of thermal protective device designed to protect motors consists of a bimetallic strip, which is near the motor winding. Should the stator winding overheat, the bimetallic element will expand and open the motor circuit. Note in this case the heat supplied to trip the relay is the actual heat generated within the motor winding. The device may be designed to reset automatically when the temperature of the motor returns to normal, or it may be reset manually. In protecting small motors the tripping mechanism is connected directly in the motor circuit. When used with large motors, it operates to open the connected circuit breaker or motor starter. Such relays are often used to operate an indicating device, warning the machine operator

TYPICAL CHARACTERISTICS OF THERMAL ELEMENTS

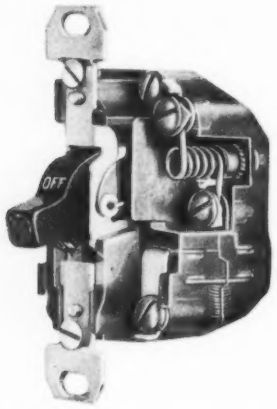


9 Tripping point of most thermal devices changes with temperature of surrounding air. Elements with automatic compensator are available

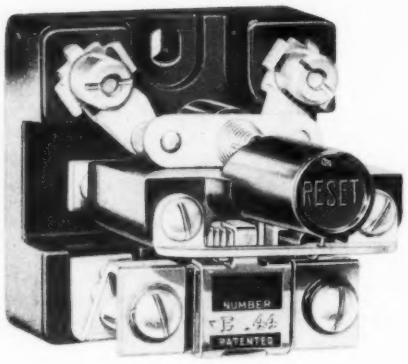
10 Trip and reset time is shown. Resetting may be automatic or manual. Automatic reset often used if motor to control distance is large



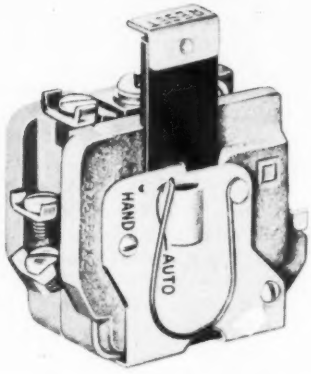
PROTECTIVE DEVICES EQUIPPED WITH THERMAL OR



11 Switch used for starting fractional-hp motor. Thermal element is shown



12 Relay having an alloy-pool element. Top terminals in series with line



13 Relay may be adjusted to reset automatically or manually as shown

that the motor is reaching a dangerous temperature.

Ambient Temperature. Most thermal devices are affected by changes in the surrounding temperature. This is illustrated in Fig. 9. It is thus good practice to have both motor and protective device subjected to the same ambient temperature. Where this is not practicable, the variation in surrounding temperature should be taken into consideration in selecting the proper thermal relay.

To illustrate, if the motor is outdoors and the thermal relay inside, both will generally be at the same temperature in warm weather. In winter, the relay will be subjected to a higher temperature than the motor. This is not serious since we will obtain adequate motor protection, even though we do limit the motor output. If the motor is located at a point where the ambient temperature is higher than that surrounding the protective thermal relay, it will be necessary to select a heater coil with lower rating to get adequate protection.

A thermal device is available to compensate for variations in the ambient temperature about the relay. When conditions are such that the relay ambient temperature changes, a compensating element built into this type of relay recalibrates the tripping mechanism. As a result, the thermal element is not affected by local temperature conditions, but trips only on motor current.

Maintenance. Thermal relays ordinarily require little maintenance other than occasional inspection. Relay terminal connections should be checked for tightness since any heat generated at these points will affect the relay's normal operation. One of the most frequent causes of false tripping or failure to trip on overload is poor selection of the thermal heater or coil. Manufacturer's recommendations should be followed in selecting thermal relays.

The tripping point of an overload protective device may be checked by passing a low-voltage current through it. For thermal relays used for motor protection, the point of tripping may be checked without removing the relay from its normal mounting. Through the use of a step-down transformer, in which the secondary voltage is but a few volts, high current can be obtained to check thermal relays. When so used, the secondary of the test transformer is connected directly to the thermal device; the value of current may be varied by selecting the proper taps on the secondary of the transformer. A clamp-on ammeter simplifies current measurement. A comparison should be made between the tripping characteristic curve supplied with the relay and the result obtained through this test.

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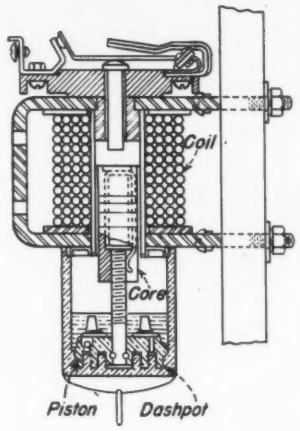
Magnetic Devices. The earliest overload device, other than the fuse was the simple magnetic relay. It consists of a wire coil connected in series with the circuit being protected. A metal plunger located within the coil is mechanically connected to some type of circuit interrupter. When a predetermined value of current flows through the coil, the resulting magnetic action raises the plunger, which in turn opens the circuit.

This relay will operate instantaneously when its calibrated value of current passes through the coil. It is thus not suited for motor protection for two reasons: (1) If the relay is calibrated to operate at a point slightly above the normal full-load rating of the connected motor, the relay will trip under the current surge on starting. (2) If the relay is calibrated to carry the heavy starting current, it will not offer overload protection to the motor once it is running.

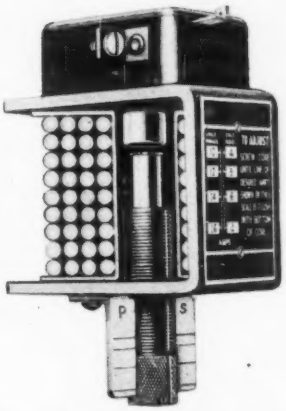
Time delay was originally introduced in this type relay by the addition of leather bellows and a calibrated air valve. On overload the plunger acted to force trapped air within the leather bellows out through the calibrated air valve. The length of time delay is controlled by adjustment of the valve opening. The leather bellows introduced a maintenance problem in that it is necessary to keep the bellows soft with oil. If allowed to dry out they will crack.

Time delay is also introduced by the addition of a dashpot as shown in Fig. 14. The attachment prevents the relay from operating on harmless surges and short-time overloads. When overload current flows, the plunger is pulled upward by magnetic action. Time delay is introduced by regulating the size of opening through which the dashpot oil must pass. In addition, the viscosity of the oil used will affect the period of time lag. A variation in the

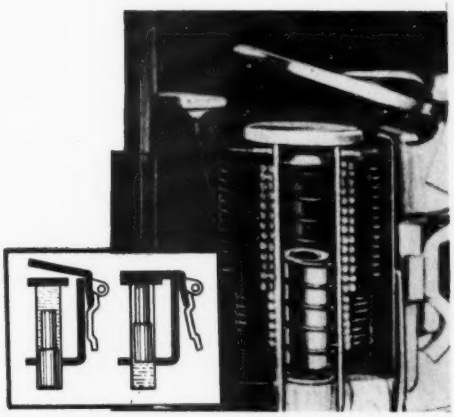
MAGNETIC ELEMENTS TO DETECT OVERCURRENT FLOW



14 Magnetic overload relay with dashpot for time lag on short overloads



15 Heat to operate results from current induced in center copper tube by coil



16 Magnetic trip provided with time lag for surges. Fast trip on short circuit

dashpot arrangement is shown in Fig. 16.

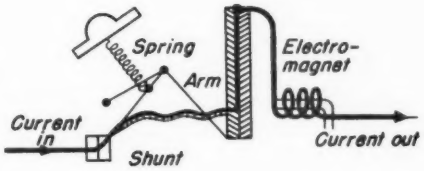
Thermo-Magnetic Devices. The circuit breaker shown in Fig. 19 combines the magnetic and thermal principles, giving accurate inverse-time overload protection. As in the curve of Fig. 20, the resulting graph is a combination of both thermal and magnetic characteristic curves. Magnetic action protects the connected motor on starting and quickly disconnects it on large load peaks. Continuous overload or a series of load peaks, which would in effect add up to a dangerous overload on the motor, are controlled by the thermal element.

Circuit breakers, which use a magnetic element to detect the flow of false current, shown in Fig. 16, operate instantaneously on short circuits, and provide time delay for short period overloads. Owing to the absence of any heating process, there is little heat loss within the relay. This is an important consideration where circuit breakers have to be grouped together. Relays of this type are not affected by changes in ambient temperature.

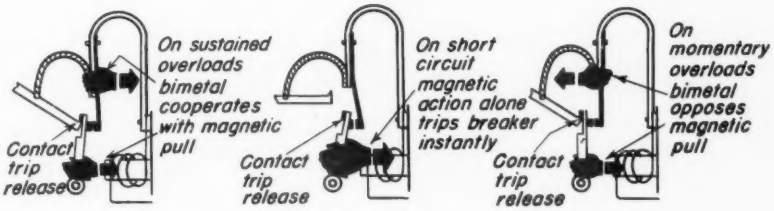
Both thermal and magnetic devices are usually rated at 125% of full-load current rating of the connected motor. For an alternating-current squirrel-cage motor, this point would correspond to the maximum allowable temperature that would be produced in the motor.

For direct-current motors the maximum safe commutating ability, in addition to winding temperature, must be considered in determining the maximum current.

COMBINED THERMAL MAGNETIC

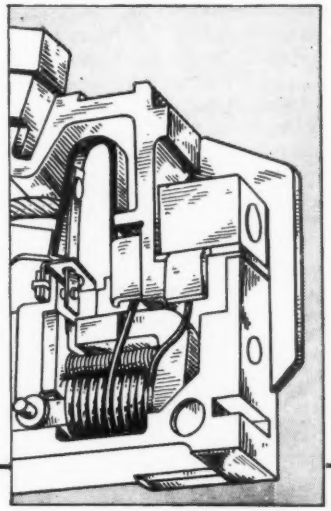


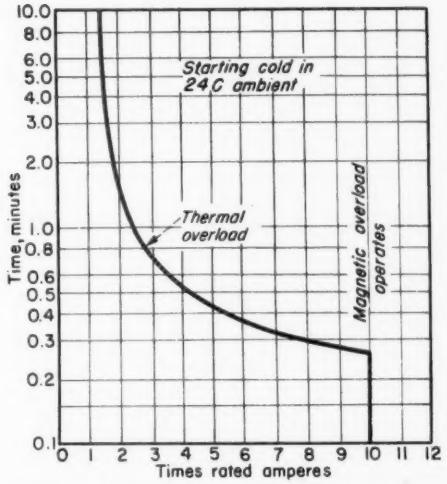
17 Combining features of both elements. Thermal operates on overloads while magnetic trip handles short-circuit faults


On sustained overloads bimetal cooperates with magnetic pull
Contact trip release
On short circuit magnetic action alone trips breaker instantly
Contact trip release
On momentary overloads bimetal opposes magnetic pull
Contact trip release

18 Retarding action of bimetallic, which operates against pull of magnetic element, prevents breaker from operating on momentary surges

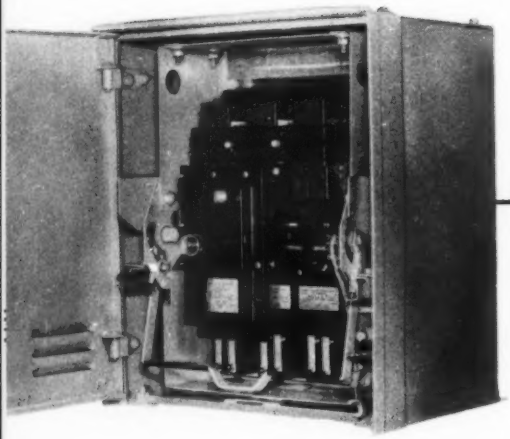
19 Both elements are contained in the circuit breaker shown below

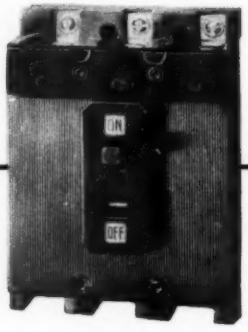


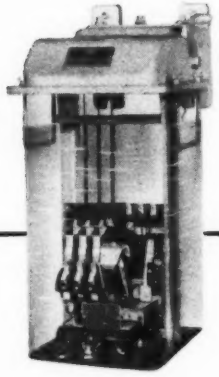


20 Tripping characteristics of both devices combined in above curve

PROTECTION ON PARADE







APPLICATIONS

All electrical circuits use overcurrent protective devices to guard against short circuit and overload. Strictly speaking, they do not protect against short circuit since some damage has been done at the trouble point by the time the fuse or circuit breaker opens. In applying protective devices in electrical circuits, the aim is to localize the fault quickly, and hence confine or reduce any possible damage.

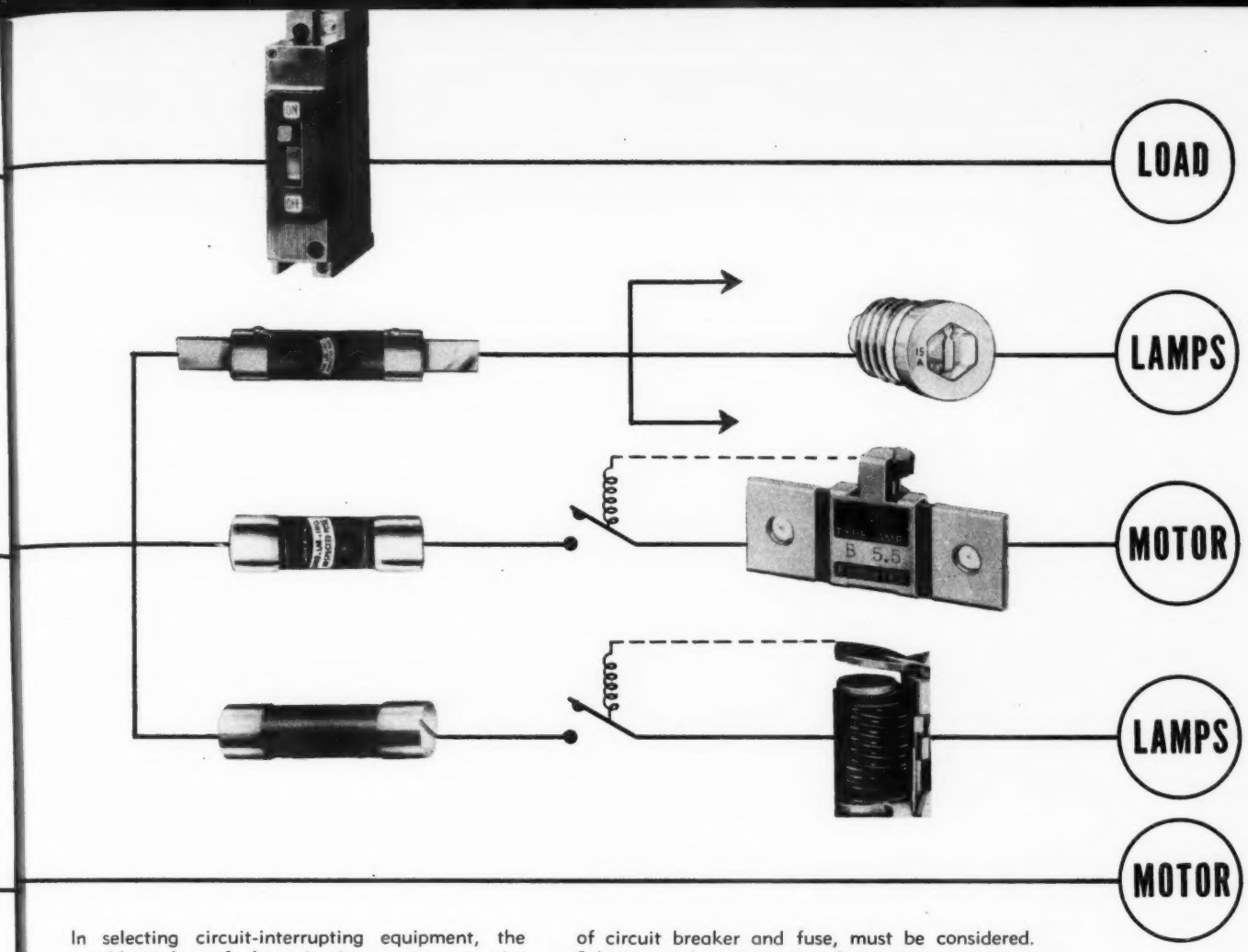
When selecting a device for short-circuit protection, the unit best suited is the one that opens the circuit quickest. The ordinary nonrenewable fuse and the simple magnetic device will act fastest on the flow of short-circuit current. The thermal element on the other hand has an inherent time-lag which makes it suitable for overload but not short-circuit. Circuit breakers equipped with both thermal and magnetic trips offer suitable protection against both conditions.

Motor Protection. The simple thermal overload relay used in a motor starter does not as a rule provide short-circuit protection. A fuse or circuit breaker should be installed ahead of the starter to operate on short circuit. For one alternating-current motor the inrush or transient current is in the neighborhood of 140 to 180% of the locked-rotor current. Locked-rotor current is that value which would flow were the full voltage applied while the rotor was held in a standstill position.

The locked rotor current of alternating-current motors is frequently about 750% of the full-load current. Hence, select a breaker that has an instantaneous tripping point of 140 to 180% of the locked rotor current. Generally speaking, for normal-torque motors the instantaneous tripping point of the breaker under consideration should be 12 to 14 times the full-load current rating. The National Electrical Code states that circuit breakers used for motor protection must have a continuous current rating of not less than 115% of the full-load rating of the motor.

In selecting a circuit breaker to protect a feeder circuit supplying several motors, the instantaneous trip point of the breaker should be eight to nine times the aggregate of the full-load current of the motors; this is a generally accepted rule when full-load current of all motors on this circuit is not greater than 100 amp. Where the full-load current is between 100 and 600 amp, the tripping point of the breaker should be six to seven times the full-load value.

The starting current of direct-current motors is generally less than that of alternating-current motors. It is recommended that the instantaneous tripping point of the circuit breaker, which is to supply short-circuit protection, be set six to seven times the full-load current



In selecting circuit-interrupting equipment, the possible value of short-circuit current at point of installation, as well as interrupting capacity of circuit breaker and fuse, must be considered. Selection and arrangement of protective equipment shown above should not be construed as typical

of one motor, or the sum of the full-load current for several motors. Where there are several motors on one feeder, it is assumed they will not all be started at the same time.

Circuit Breakers. An air circuit breaker must have an interrupting rating equal to or greater than the maximum short-circuit current that may flow at that point in the circuit where the breaker is to be installed. For example, when a single circuit breaker is placed between the power source and the load, its interrupting rating must be equal to or greater than the average total calculated current at one-half cycle from the time short circuit was applied.

This is the conventional application, and is the rule when a single circuit breaker is placed between the power source and the load.

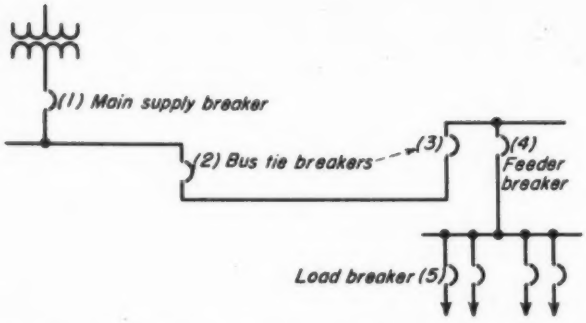
Cascading. Consider a distribution system consisting of a main circuit breaker A feeding a bus to which is connected four feeder breakers B, each of which in turn feeds several subfeeder breakers C. If the tripping points of these circuit breakers are properly coordinated, breakers B and C may be applied beyond their interrupting ratings. Such a sequence of properly coordinated breakers is known as a cascade. Proceeding from the source toward the load, breakers in cascade have a progressively lower standard interrupting rating. The central idea in cascading is to have breaker A set to trip at 80% of the maximum interrupting rating of B. Circuit breaker B in turn should trip at 80% of the maximum interrupting rating of C. All breakers so arranged will trip instantaneously at their set value of current.

The conventional application of circuit breakers is recommended in all cases, but may not be economically justifiable on all installations. Where all breakers are located in the same switchgear assembly, cascading is often used.

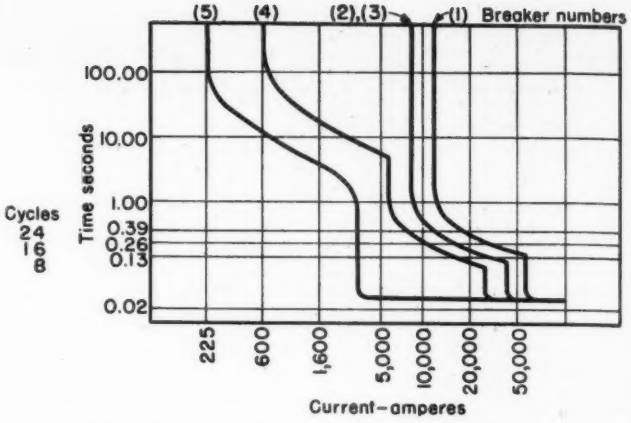
Selective Operation. Air circuit breakers are available with delayed overcurrent trips designed so the breaker may be used in a completely selective distribution system. The term, selective operation, means that a fault at a remote point in the system will not shut down the whole distribution system, by tripping the main supply breaker. Instead, only the breaker nearest the fault opens; consequently the disturbance is limited to the smallest possible portion of the system. Selective operation is obtained by an accurate tripping device, which introduces time delay into the tripping time of the breaker. Referring to Fig. 1, the tripping time of the main supply breaker is greater than that of the bus tie breaker, which in turn exceeds that of the feeder breaker.

For example, let us assume a fault current of 20,000 amp flowed

SELECTIVE DISTRIBUTION SYSTEM



1 Selective operation is obtained through use of calibrated tripping device, introducing time delay into each breaker



2 Tripping time of main supply breaker is greater than that of bus tie breaker, which in turn exceeds feeder breaker

in the circuit shown above. Referring to Fig. 2, breaker No. 5 will operate, clearing the fault, if the short circuit occurred beyond this breaker. Note that although the fault current passed through breakers 1, 2, 3 and 4, these breakers did not operate. Should the load breaker 5 fail to operate, or if the short circuit occurred between breakers 4 and 5, breaker 4 would operate in approximately 8 cycles. Complete selectivity at all times may be obtained in a chain of as many as four circuit breakers in series.

•

Lighting Load. Ideal overload protection for a lighting system provides for uninterrupted service during periods of momentary overload. At the same time it provides immediate opening of the circuit in the event of a short circuit. Keep in mind the facts outlined in the following paragraph when selecting overcurrent protective devices for use in lighting circuit.

Incandescent. The incandescent lamp, when cold, has a resistance about 1/14 of that when it is hot. This causes a high inrush of current when the circuit is first closed. The most serious condition occurs in an alternating-current circuit when the breaker is closed with the voltage at its peak. Here, instantaneous current drawn is about 14 times normal value. This current is slightly less for lamps below 100 watts. In a direct-current circuit the inrush current is about seven times normal value. In either case the duration of the inrush current is short, varying from 2½ cycles in small lamps to 12 cycles in 1000-watt lamps.

To cope with this problem, circuit breakers are available that have a high tripping value for a short time after the breaker is closed. Shortly after the load current reaches its normal value, the tripping point of the breaker decreases to a value slightly greater than that of the normal current. In this manner, full protection is provided without unnecessary circuit interruption.

Mercury Vapor. Starting and operating characteristics of the mercury-vapor lamp, which requires a transformer or ballast on starting are quite different from those of the incandescent lamp. The starting current of each type of lamp varies in peak value and duration. When operated with single-lamp transformers, the 400-watt Type H-1 lamp has a peak about 1.7 times normal and requires about 15 minutes to reach normal operating value. In contrast, the 2 lamp 400-watt style, with ballast, has a starting current of 0.6 that of normal. This builds up to full current in about 25 min.

Fluorescent. Current behavior in fluorescent lamps is quite different from that in incandescent or mercury-vapor lamps. The starting current is practically normal. When the transformer comes into use, the peak is only 1.8 times normal. This high current lasts for only two or three cycles.

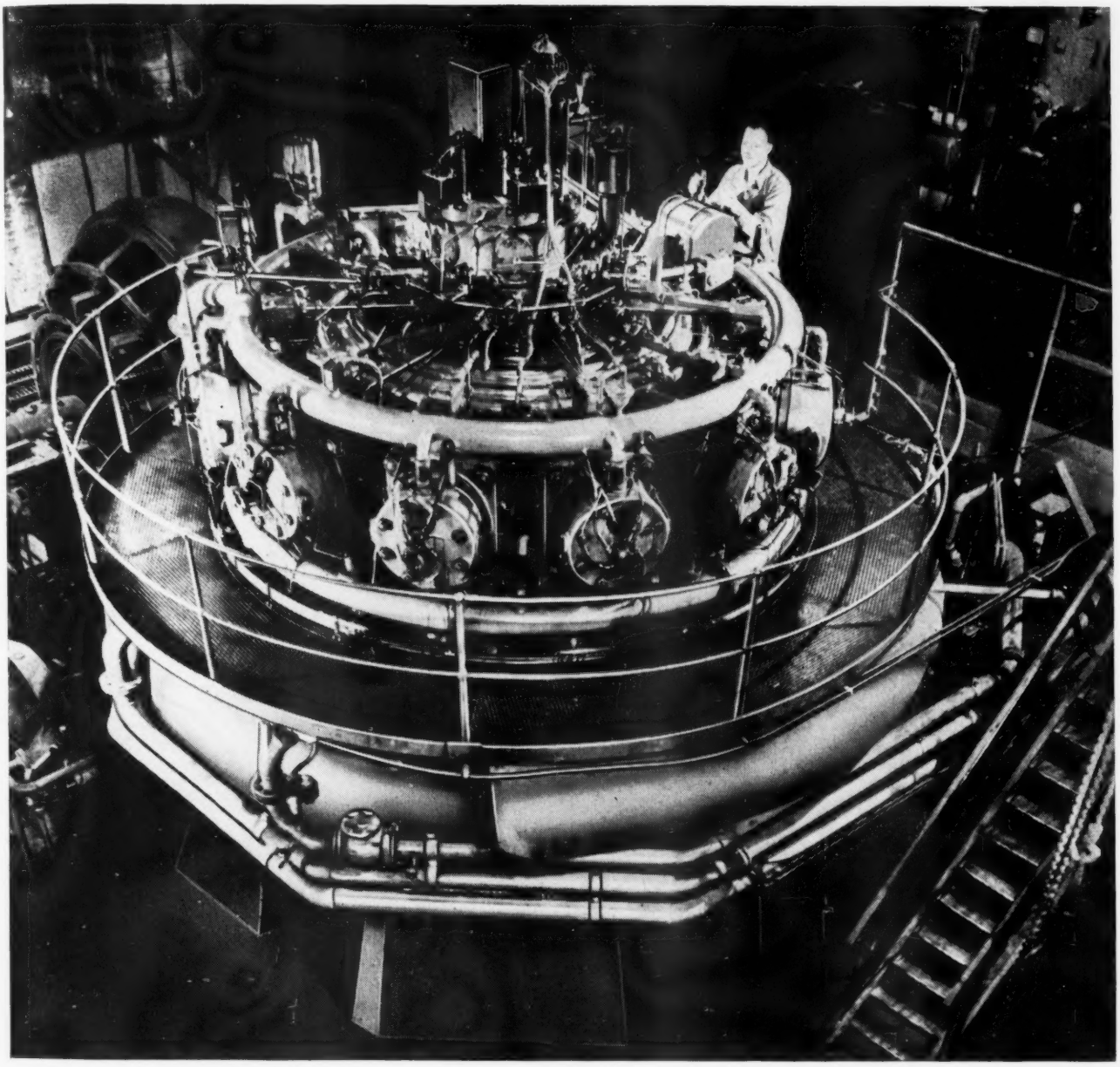
•

Fuses. Where fuses are used to protect circuits, their rating should not be greater than the current-carrying capacity of the wire. The exception to this rule occurs when the current-carrying capacity of the wire does not correspond to a standard-size fuse; the nearest larger standard-size fuse may be used.

A variation from the above rule occurs in the application of fuse protection to motor circuits. All motors rated over 1 hp. must have running protection. Such security is offered by thermal cutout fuses, as well as those having large time-lag. The ordinary fuse on motor circuits protects only against short circuit. The thermal device, which offers running protection to the motor, also protects the feeders against overload.

ACKNOWLEDGMENTS

In the preparation of this special section, the published literature was freely consulted; in addition, for liberal use of technical data, POWER is indebted to the following manufacturers: Allen-Bradley Co, Allis-Chalmers Mfg Co, Brown Boveri Corp, Bulldog Electric Products Co, Bussmann Mfg Co, Cook Electric Co, Cutler-Hammer Inc, Eagle Electric Mfg Co, Economy Fuse and Mfg Co, Electric Controller and Mfg Co, Federal Electric Products Co, General Electric Co, Heinemann Electric Co, Ideal Industries Inc, I-T-E Circuit Breaker Co, Jefferson Electric Co, Kirkman Engineering Co, Monarch Fuse Co, Railway and Industrial Engineering Co, Royal Electric Co, Solar Electric Corp, Square D Co, Trico Fuse Mfg Co, Trumbull Electric Mfg Co, Ward Leonard Electric Co, Ware Brothers Mfg Co, Westinghouse Electric Corp.



1150-KW RADIAL ENGINE GENERATOR installed for experimental purposes at Aluminum Ore Co plant. New units are similar

Radial Engines for Aluminum Works

▶A LARGE RADIAL ENGINE-GENERATOR, embodying many unusual design features, was shown to diesel engineers attending the 20th national conference of the Oil and Gas Power Division, ASME, held at St. Louis, May 20-22. Built by Nordberg Mfg Co, and operating two years at East St. Louis plant. of the Aluminum Ore Co, this unit is the prototype of 80 similar engine-generator sets recently ordered by the Aluminum Co of America to form the power plant for two pot lines to be installed at a Texas site.

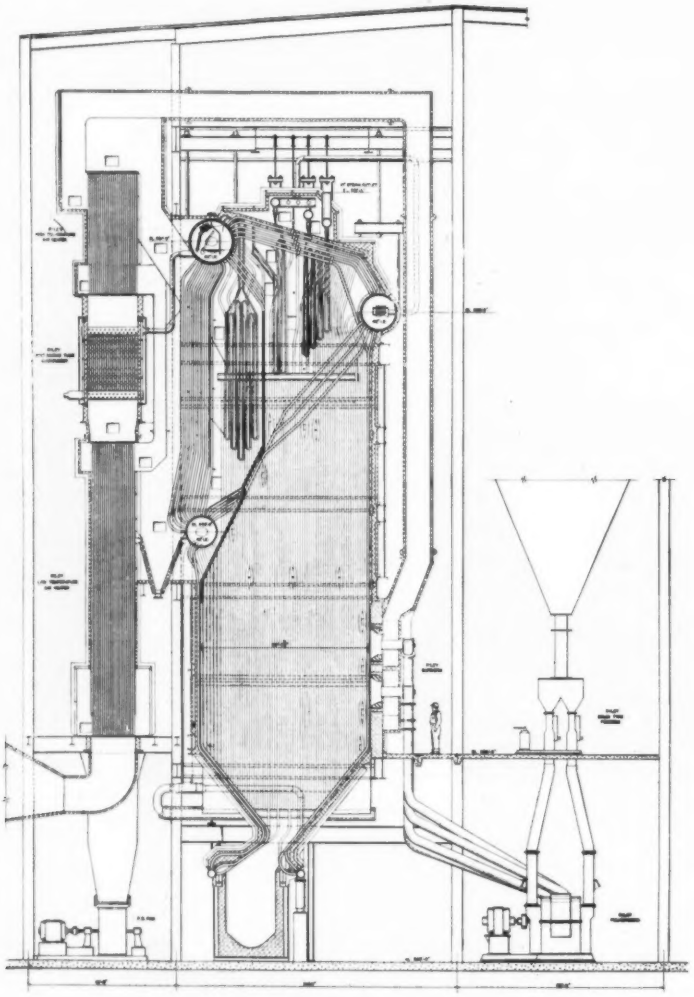
Developed in cooperation with the Aluminum Co, the radial design is said to have features making it particularly suitable for continuous heavy-duty service in plants of large total capacity. Experience with internal-combustion engines for pot-line power production was gained by Alcoa in building and operating the Defense Plant Corp plant at Jones Mills, Ark., believed to be the present world's largest internal-combustion-engine plant. Two of its four pot lines are supplied by transmission line and rectifiers, the others by 18 Nordberg gas diesels of the high-pressure injection type, and by 50 Cooper-Bessemer spark-ignition gas engines. Total engine-generator capacity is 78,000 kw. For a complete description of this plant, now owned by Reynolds Metals Corp, see POWER, Nov 1944 pp 64-69.

(*Continued on page* 98)

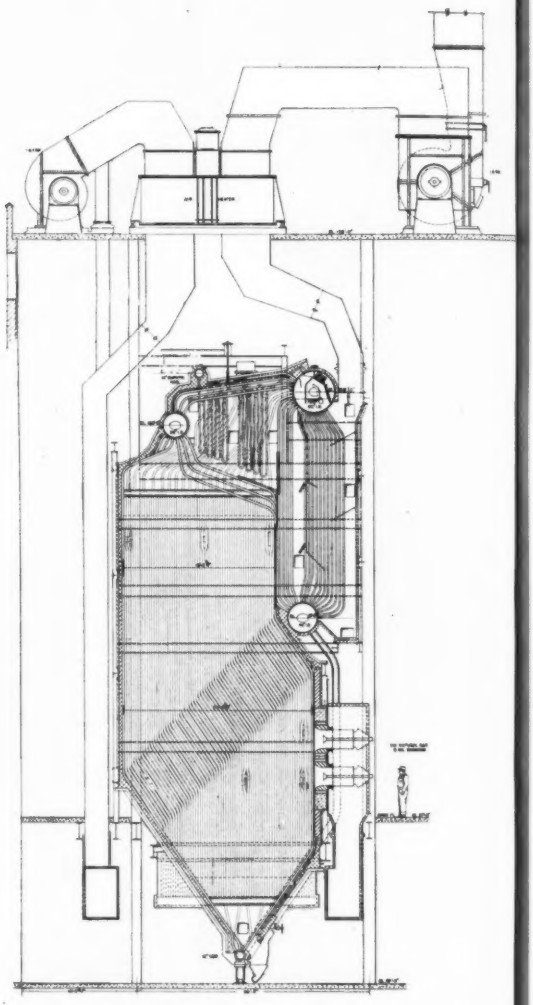
More Riley Boiler Units are being

More Riley Steam Generating Units are being installed today than ever before. This is because existing Riley units are giving such satisfactory service that users not only invariably order more Riley units when additional units are installed, but also because more and more of the leading central-station and industrial plants are selecting Riley units.

A visit to a number of existing Riley installations will make the reason for this increasing preference for Riley equipment perfectly clear. You will find units giving unusual service from every standpoint. You will learn you can rely on Riley. When considering steam-generating or fuel-burning equipment Riley is the name to remember.



NORTHERN VIRGINIA POWER CO., Riverton Station, Winchester, Va.
350,000 lbs./hr., 1,100 lbs., 990°F., fired by Riley Pulverizers and Burners
Sanderson & Porter, Engineers



NEW ORLEANS PUBLIC SERVICE CO., Louisiana
330,000 lbs./hr., 450 lbs., 725°F., Oil and Gas Fired
Ebasco Services, Inc., Engineers

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Cleveland Detroit Chicago St. Louis Cincinnati St. Paul
Pittsburgh Kansas City Denver Seattle Portland Los Angeles Houston New Orleans Atlanta Memphis Tulsa

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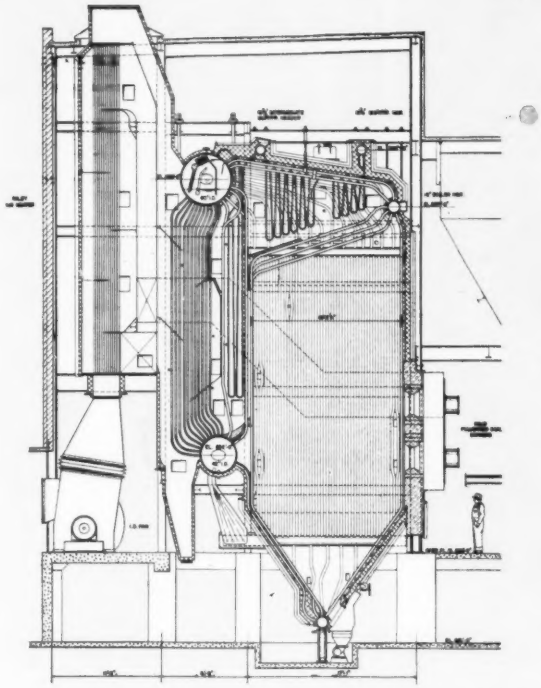
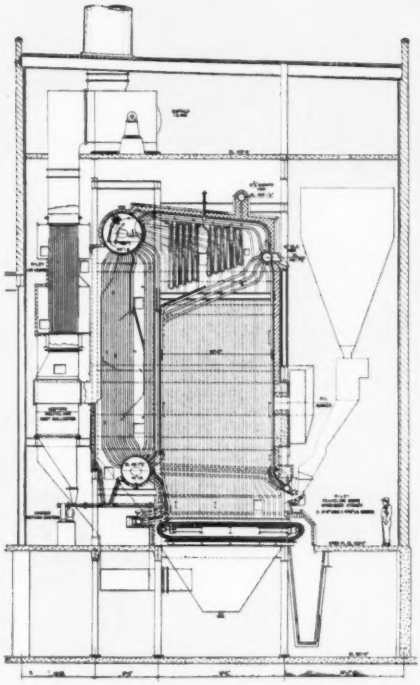
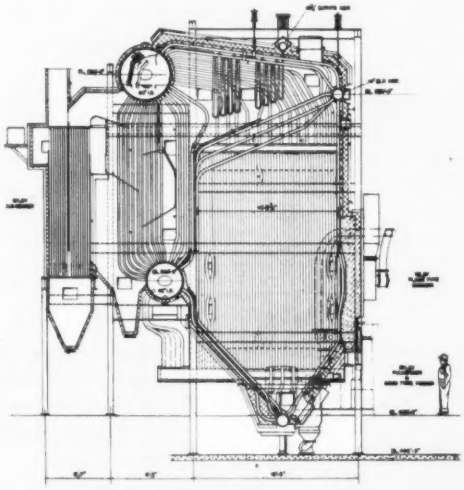
installed today than ever before



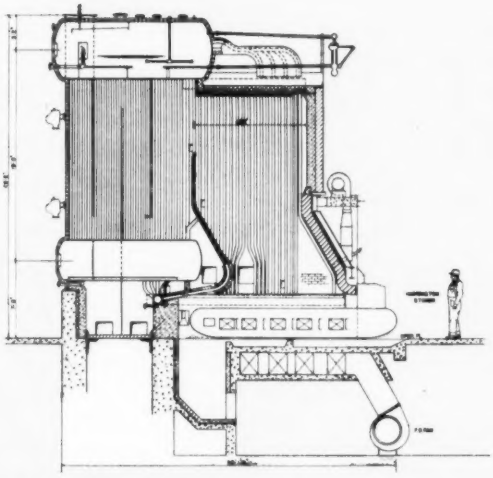
CENTRAL OHIO LIGHT & POWER CO., Bluffton, O.
120,000 lbs./hr., 500 lbs., 835°F.,
Pulverized Coal Fired
Sargent & Lundy, Engineers
Central Ohio has installed 6 Riley Units



CITY OF PROVO, Utah
100,000 lbs./hr., 475 lbs., 750°F., fired by
Riley Spreader Stoker



NORTON COMPANY, Worcester, Mass.
50,000 lbs./hr., 740 lbs., 750°F., fired by
Riley Pulverizers and Burners
Sill & Warrington, Engineers
The third Riley Unit in this plant



INDUSTRIAL RAYON CORP., Cleveland, Ohio
55,000 lbs./hr., 180 lbs., saturated
fired by Riley-Harrington Stoker

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

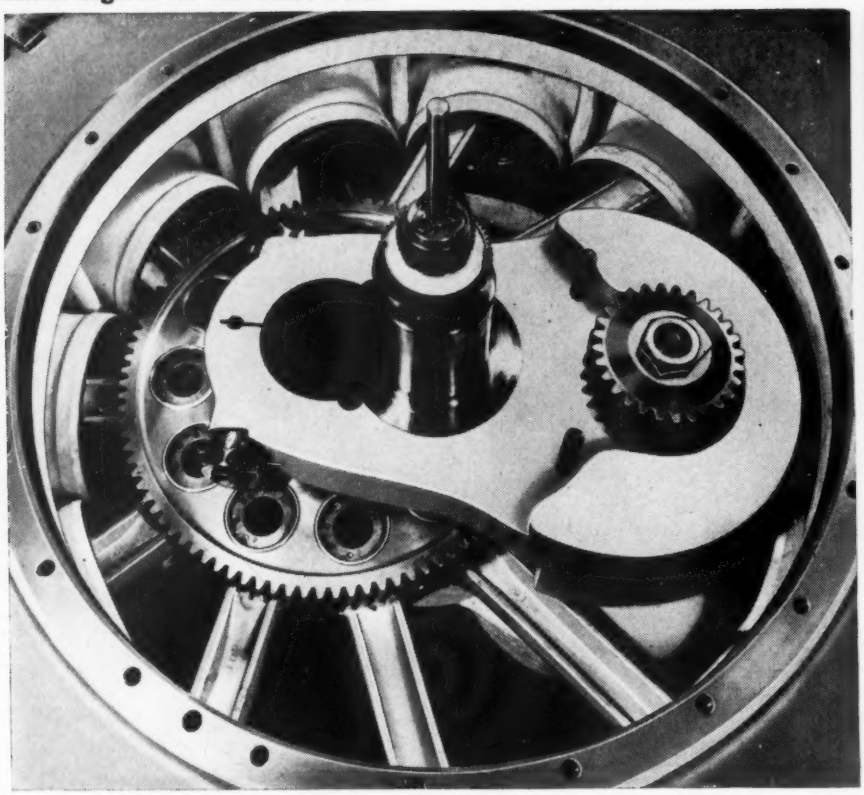
COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

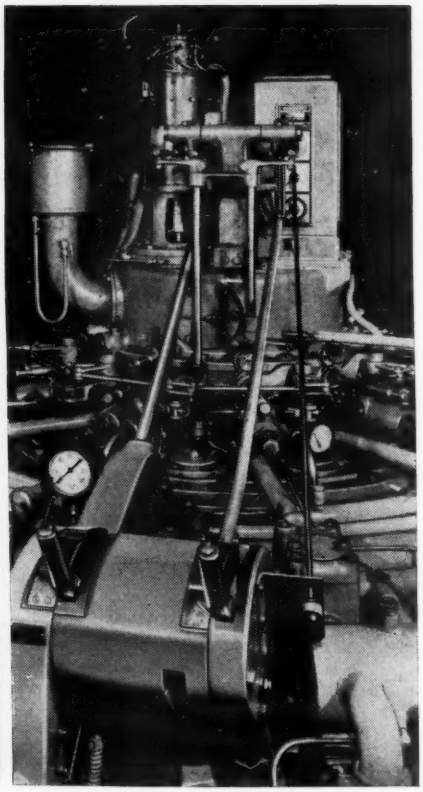
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

Radial Engines for Aluminum Works

(*Continued from page 95*)



CONNECTING-ROD ASSEMBLY of unique design eliminates master rod, provides complete balancing. Stationary gear on cover, not shown, meshes with upper pinion



CONTROLS are dual, providing for operation with either gas or oil as fuel

As shown in the photo above, the engine has 11 cylinders of 14-in. bore and 16-in. stroke. At 400 rpm it develops 1800 hp or 1250 kw. Operating on the 2-stroke cycle, it has a motor-driven centrifugal scavenging blower mounted on the floor, at right rear in the photo, under the main platform. The blower motor and the other auxiliaries operate on 25-cycle ac from slip-rings on the dc generator. This arrangement permits quick starting without an outside power source and also without need for excessive interrupting capacity. Since the blower motor requires about 100-kw input, the net capacity of the set is 1150 kw. (See also pp 138, 172.)

The exhaust header can be seen just below the operating platform encircling the engine. Another straight manifold, which is not visible, supplies the scavenging air to the cylinders. Headers above and below the cylinder heads are for cooling water. Auxiliaries—water and oil pumps, etc—under the main platform cannot be seen in the photo.

Radial design with the generator below produces a balanced engine requiring a relatively simple and inexpensive foundation, low headroom and comparatively little floor space. The unit is about 12 ft in diameter across the cylinder heads and about 15 ft high from the base to the top of cylinder assembly.

Engine crankshaft is vertical, with the crank at the top and the generator below in the coolest zone. Engine and generator shafts bolt together just below the engine; generator shaft has a steady bearing at the base. This prototype unit has concrete supporting piers; the sets for the aluminum works in Texas will have cast-iron supports.

The cylinders bolt to a central frame consisting of a single casting having a central hub that carries the lower crankshaft main-bearing bushing and a thrust bearing that supports the crankshaft and generator load. A cover bolted to the top of the frame carries upper main-bearing bushing; mounted on this cover are the governor, fuel pumps and control mechanisms. Cylinders have ports for inlet and exhaust; there are no valves.

Method of attaching connecting rods to the crankpin is unique and eliminates the master rod often used in radial designs. As shown in the photo above, the connecting rods have a bronze bushing at the crankpin end. Pins connect rods with a master gear assembly. Counterweight shown carries two pinions: one below (not visible) which meshes with the master gear, and another above on the same shaft, which meshes with a stationary gear fastened to the cover and not shown. The master gear does not rotate, but its gyratory action causes the pinions to "walk" around it, rotating the counterweight. All bearings, including the mains, are bushings; there are no split bearings.

Mechanical lubricators force-feed the cylinders; all other parts are lubricated by a circulating pressure system. A motor-driven rotary lube-oil pump takes its suction from the sump tank and discharges to the lower main bearing. Oil then enters a drilled passage in the shaft and is distributed to crankpin bearings in the master gear, to the pinion bearings and to the upper main bearing. Drilled passages in the connecting rods supply oil to the wristpins. Aluminum alloy pistons are oil cooled.

Units of this design will be built as oil diesels, spark-ignition gas engines, and duafuel engines capable of operating with either oil or gas fuel on the diesel cycle. The engine shown at East St. Louis was built for use of both oil and gas, with dual controls (see photo above). The 80 engines on order are for gas, with spark ignition.

5,000,000 Youngsters Need Our Help Now

THE bumper wartime crop of babies, about 5,000,000 larger than the population experts expected, is reaching school age.

At school these youngsters should find a good education awaiting them. That is their most cherished American birthright.

But unless something is done quickly, millions of these children will be cheated. They will crowd into classrooms already run on double shifts. They will move in with children who are now sitting two in a single seat. They will read germ-loaded books mangled by a generation of use by grimy hands.

I

So the continuing crisis in American education is given a new twist by unexpected pressure on school plant and equipment.

The U. S. birthrate has jumped by leaps and bounds. Instead of declining in the '40s, as the experts expected it would, the rate climbed from 17.9 per thousand in 1940 to 21.5 in 1943. It jumped to 25.9 in 1947, an increase of 45 percent since 1940. Result—by 1956 elementary school attendance in the United States is expected to jump from 18,200,000 to more than 23,400,000, an increase of about 5,200,000, or more than one-fourth.

The rush has already begun. It will pick up speed next fall.

Now, while this pressure has been building up, our public schools and their equipment have been running down—first through inevitable wartime neglect, then because inflation and material and labor shortages made it difficult to catch up.

If we are to give this bumper crop of youngsters the break they deserve—and reach the educational standards the nation needs—we must speedily do a major job of educational rehabilitation and expansion.

II

Some headway has been made in overcoming the teachers' salary crisis.

Teachers' salaries are improving. Pay problems were driving good teachers away from their posts in droves not long ago. But in the year since the 57th editorial in this series emphasized that crisis, the average teacher's annual salary has increased about $300—from $2250 to $2550.

True, increases vary enormously from state to state and from town to town. In a few states the average increase has been $500; in some less than $100. But, for the nation as a whole, last year's increase put teachers about even in the race with the cost of living. After taxes, their salaries have risen 68%, and the cost of living 67%, since 1939. In terms of pay increases, however, they are not nearly as well off as are industrial workers, whose average weekly wages after taxes have risen 108% since 1939. They are far behind farmers, whose net income is now four times what it was in 1939. And teachers had notoriously low salaries to start with.

A great deal more needs to be done in raising salary standards to put our school system on a firm footing. There are still about 100,000 teachers, nearly 12% of all public school teachers, who hold temporary or emergency credentials. They cannot meet

prevailing standards, and not very severe standards at that, for persons holding their posts.

The salary crisis, however, is easing.

III

But now comes the new crisis in school buildings and equipment.

We would have been hard put to get our schools back into shape after years of wartime neglect—even without a booming birthrate complicating the problem. Right now, 85% of all public school buildings need major remodeling to remove health and safety hazards.

And we aren't building enough new schools to keep up with current needs, to say nothing of catching up on those we were not able to build during the war years. School construction expenditures for 1948 are estimated at $375 million – which is less than what was spent in 1939. With building costs twice as high as they were in 1939, that means we aren't even holding our own—we are falling further behind.

And now comes the rush of war babies.

IV

We must spend at least $11 billion on new schools and equipment in the next decade.

Public and elementary schools must have $6.6 billion. Equally important, another $4.4 billion must be invested in buildings and equipment in our private schools, colleges and universities if they are to meet the demands which will be made upon them. The private school and the privately endowed university are doing their full share and doing it well. The need for them is increasing.

These figures cover only rockbottom needs for educational plant and equipment. But statistics are a very restricted recorder of this crisis.

You can see it better, I'm sure, in schools not very far from your home. There are schools with leaking roofs and outdoor toilets in our greatest cities. There are schools where students still use histories and geographies copyrighted before 1920—books with no mention of World War I, the depression of the 1930's, the Russian Revolution or the rise of the dictators. There are countless schools where modern methods of visual education are completely unknown.

All of these conditions promise to get worse – promptly – as that scheduled 5 million increase in the school population gets rolling.

V

The Metropolitan Life Insurance Company does not indulge in lurid prose. It says after painstaking study of the educational crisis that:

"Unless definite measures are taken immediately . . . large numbers of American boys and girls will be deprived of an adequate education."

Currently we are deeply concerned about our military defenses. We are taking, and I think rightly, emergency measures to strengthen them. But we must regard our schools as a part of our national defense as vital as are our armed forces. This is particularly true in these times of fifth columns and ideological warfare.

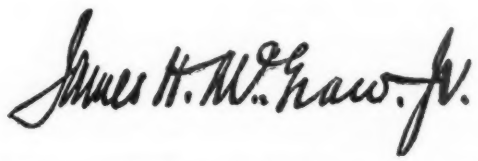
If we are wise, we will raise our sights. We will give the continuing crisis in education the same urgent attention being given the more obvious but no more real crisis in national defense.

Go to the school house in your neighborhood and discover what needs to be done to provide for the rising tide of young Americans. Ask your school board and your school administrators and teachers how you can help them.

That is good citizenship.

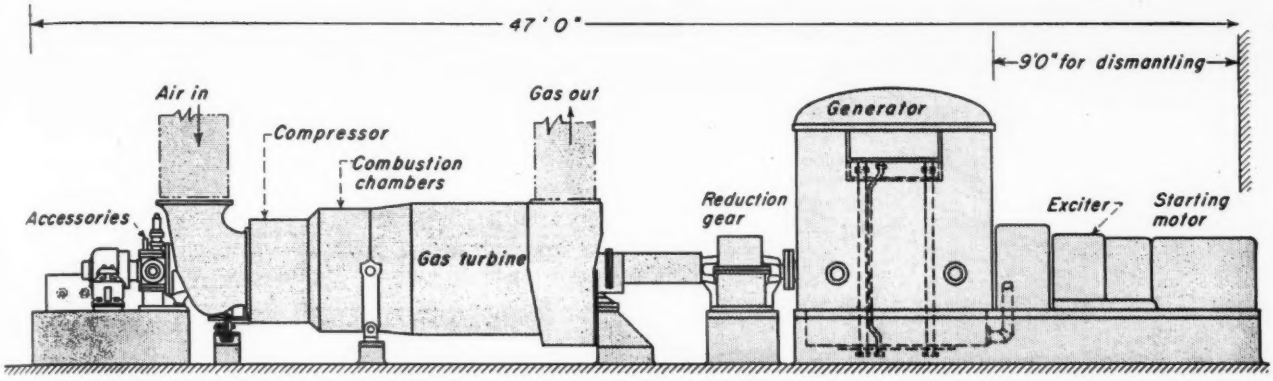
That is patriotism.

That is our duty to the oncoming generation.



President, McGraw-Hill Publishing Company, Inc.

THIS IS THE 68TH OF THE SERIES



1 **COMPLETE SIMPLE-CYCLE GAS TURBINE** to produce 3500 kw at 80-F inlet-air temperature. Unit duplicates design on plant for locomotive drive, burns fuel oil, in six combustion chambers mounted between axial compressor and turbine

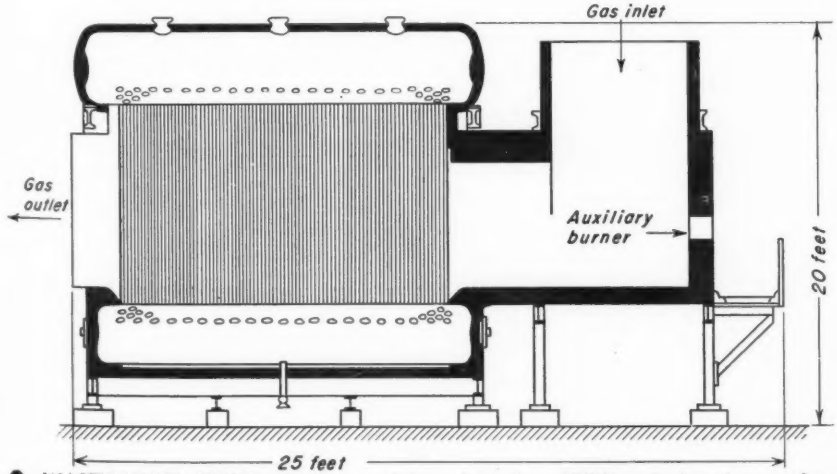
Installing Waste-Heat Boiler Increases Gas-Turbine Flexibility

Facts and figures on increasing the usefulness of gas turbines by utilization of the heat in the exhaust. Abstract of a paper by George R Fusner of General Electric Co, presented before the June 1948 meeting of the ASME, held at Milwaukee, Wisconsin

▶ WHILE A SINGLE-SHAFT GAS TURBINE with no heat recovery will find many applications, high fuel costs bar its utilization in some instances. One way of improving the plant heat rate passes the high-temperature exhaust gas through a waste-heat boiler that produces steam for process and space heating or for electrical-power generation.

Use of just a simple waste-heat boiler has the drawbacks of steam generation depending on power output and decreased steam production with low inlet-air temperature at the compressor. These handicaps can be overcome in two ways, the methods being demonstrated by performances calculated for the plant shown in Fig. 1. This unit is an adaptation of the 3500-hp locomotive unit described in POWER, May 1948, pp 95, 98.

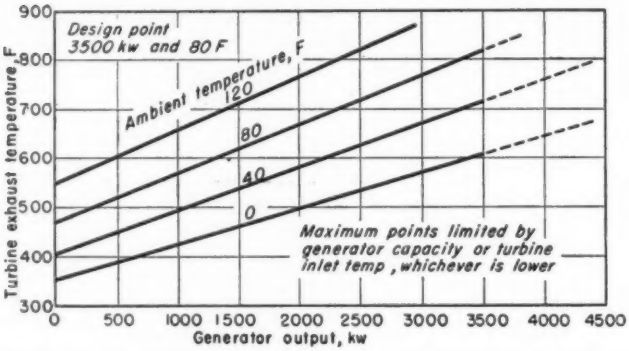
With a 75% effective boiler it is possible to generate 31,200 lb per hr of 50-psig saturated steam and 25,600 lb per hr of 200-psig saturated steam when the unit runs at its design point of 3500 kw and 80-F inlet air. Cooling the gas to steam-saturated temperature makes 43 million Btu per hr available at 50 psig and 38 million Btu per hr at 200 psig.



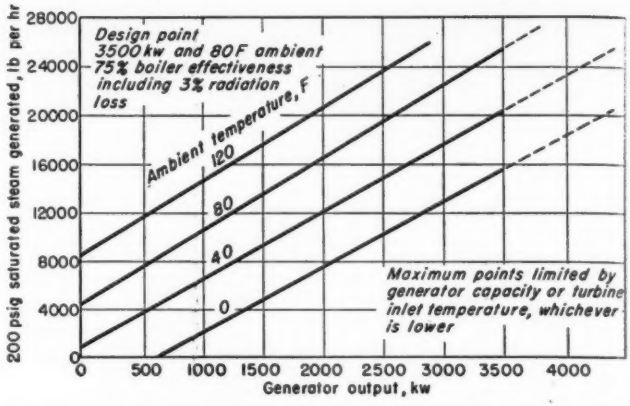
2 **WASTE-HEAT BOILER** for gas-turbine plant has 8500-sq-ft heating surface with tubes arranged 20 wide and 70 deep. Required ground area is 8x25 ft.

Waste-Heat Boiler. Fig. 2 shows one suitable type of waste-heat boiler. This unit has 8500 sq ft of heating surface, arranged 20 tubes wide and 70 deep. The 2-in. tubes are rolled into a 48-in. upper and 32-in. lower drum. Over-all dimensions are about as follows: height 20 ft, width 8 ft, length 25 ft. Boiler purchase price will be about $75,000.

Turbine Performance. Exhaust temperature of the simple-cycle gas turbine decreases with falling inlet-air temperature to the unit. Fig. 3 shows that at 3500-kw output the exhaust temperature with 80-F air temperature is 820 F, and at O-F air the exhaust drops to 610 F. These lowering temperatures decrease the steam generation in a waste-heat boiler. Fig. 4 and 5 show the effects on a 200-psig and 50-psig boiler, respectively. These performances are based on feedwater temperatures of



3 **GAS-TURBINE EXHAUST** temperature depends on both load and inlet-air temperature to compressor; increases with both


Design point
3500 kw and 80 F ambient
75% boiler effectiveness including 3% radiation loss
Ambient temperature, F
120
80
40
0
Maximum points limited by generator capacity or turbine inlet temperature, whichever is lower
200 psig saturated steam generated, lb per hr
Generator output, kw

4 Since steam generation will depend on exhaust temperature it also varies with both load and inlet-air temperature

212 F, 75% boiler effectiveness and 3% radiation loss. Marked effect of air temperature can be readily seen.

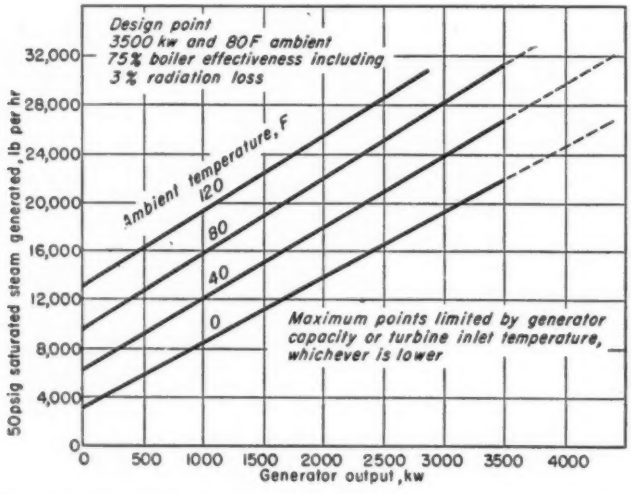
Increased Backpressure. One method of overcoming the steam capacity limitation places a throttling valve between the gas-turbine discharge and the waste-heat boiler. Throttling the turbine exhaust regulates the gas temperature. More fuel must be burned in the combustors to maintain constant kw output when the exhaust pressure increases. This increases the exhaust temperature. It thus becomes possible to regulate steam production independently of kw load and air temperature.

Fig. 6 gives performance curves for the unit operating normally compared with throttling performance, both at O-F air temperature. This shows that 31,000 lb per hr of 200-psig steam can be generated at all kw outputs by throttling the turbine exhaust. Without throttling, only 15,600 lb per hr are generated at 3500 kw, which drops to zero steam at 600 kw and below. The increased steam is obtained by raising the exhaust pressure to 3.8 psig at full load and 11.3 psig at no load. At 3500 kw the fuel flow increases from 4100 to 5300 lb per hr; at no load it increases from 1950 to 4600 lb per hr. Turbine nozzle-bowl temperature must be raised from 1085 to 1340 F at full load, and from 685 to 1200 F at no load.

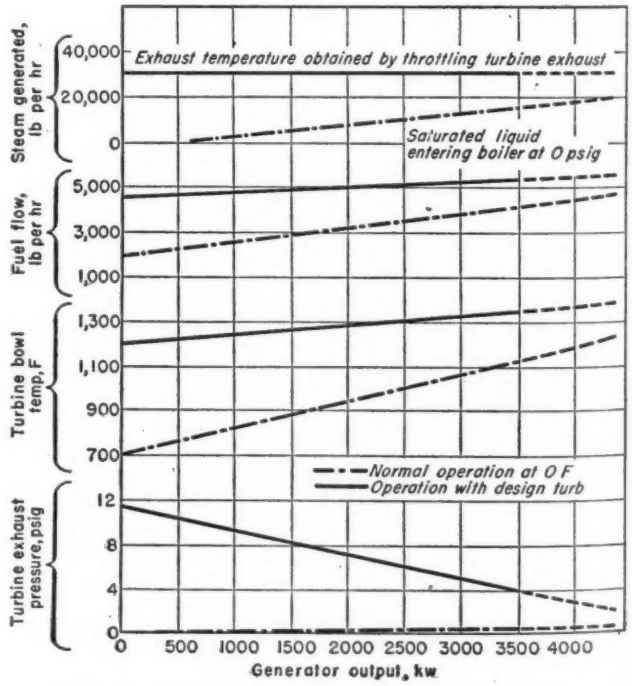
Although the turbine-exhaust temperature under throttled conditions must be limited to the normal full-load value, the average turbine temperature over a period of time will be higher than with no throttling. The turbine must be designed to operate at higher average (but not maximum) temperature.

Auxiliary Burner. An auxiliary oil or gas burner can be fired in the boiler to increase steam generation. The turbine operates normally with this arrangement. The auxiliary burner can increase the gas temperature far above the allowable turbine exhaust temperature with resulting increase in boiler output. Burning about 5000 lb per hr of oil in the auxiliary burner would produce an 1800-F gas temperature entering the boiler generating 85,000 lb per hr of 200-psig steam or 92,000 lb per hr of 50-psig steam. This arrangement is very flexible in its control.

(*Continued on page* 140)

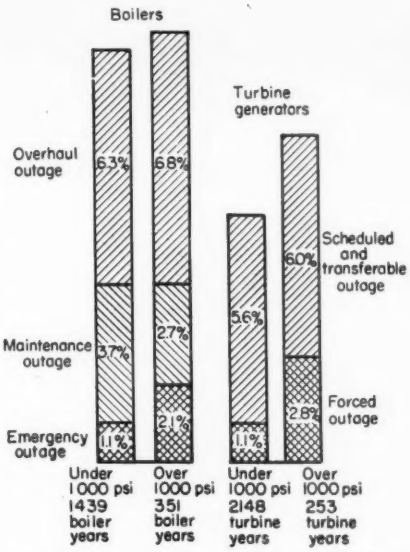


5 **AS BOILER-STEAM** pressure decreases more steam can be generated at given turbine outputs and inlet-air temperatures

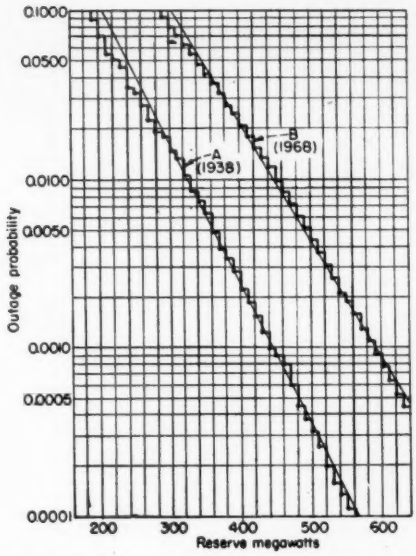

Steam generated, lb per hr
Exhaust temperature obtained by throttling turbine exhaust
Saturated liquid entering boiler at 0 psig
Fuel flow, lb per hr
Turbine bowl temp, F
Normal operation at 0 F
Operation with design turb
Turbine exhaust pressure, psig
Generator output, kw

6 **RAISING TURBINE-EXHAUST** pressure by throttling increases waste-heat boiler steam output at all turbine kw loads

What factors must the design engineer consider in deciding that he has provided enough power-producing equipment to keep step with growing load? Here is a summary of this complex, fundamental problem in the planning of a system



1 Average weekday outage rates: 5 yr of boiler, 6 yr of turbine operation. Outages are from all causes, by pressures



2 Probability of outage occurrences in excess of reserve for 1938, 1968 on Consolidated Edison Co of N. Y. system

Probability Theory Helps Determine System Reserve Generating Capacity

By **GIUSEPPE CALABRESE**, *Division Engineer, System Engineering Dept, Consolidated Edison Co of N. Y., Inc*

▶ A FUNDAMENTAL PROBLEM of system planning is the determination of station and system reserve requirements. Inadequate reserves cause undue interruptions of service while too large reserves represent wasted investment. Decisions by rule of thumb do not solve the problem. The need of analytical methods that systematically evaluate the factors involved is very apparent.

Forced Outage Rate. To meet this need a method of calculating forced-outage probabilities was devised utilizing the theory of probabilities. The fundamental unit that must be known is the *average unit forced outage rate*, q. This quantity may be defined as,

$$q = \frac{D_f}{D_f + D_o}$$

where, D_f = days of forced outage
D_o = days in operation

then q is the expected fraction of time, or probability, that the average unit of a group will be forced out of service (forced outage) during any period. Demand days equal the sum of the number of days of forced outage and of operation.

Value of q can be found from actual experience. During the early stages of the study made for the Consolidated Edison system the value of q was found to be 0.03 for turbine-generator units and 0.02 for boilers. Since that time studies made in conjunction with the Edison Electric Institute have yielded the outage figures that are shown above in Fig. 1. They are the latest data available.

Outages of Combinations. If q measures the fraction of time that the average unit is on forced outage, then $p = 1 - q$ represents the fraction of time that the average unit is in operation during a given period.

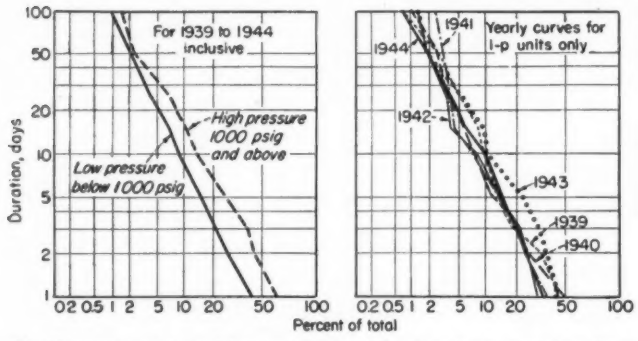
With the average outage rate established it becomes necessary to determine how this experience will affect a group of units and find the likelihood of outages of the different units occurring simultaneously. This can be done for a group of n units by expanding the term $(p + q)^n$ according to the binomial theorem.

$$(p+q)^n = p^n + np^{n-1}q + \frac{n!}{2!\,(n-2)!}p^{n-2}q^2 + \ldots + \frac{n!}{m!\,(n-m)!}p^{n-m}q^m + \ldots + q^n$$

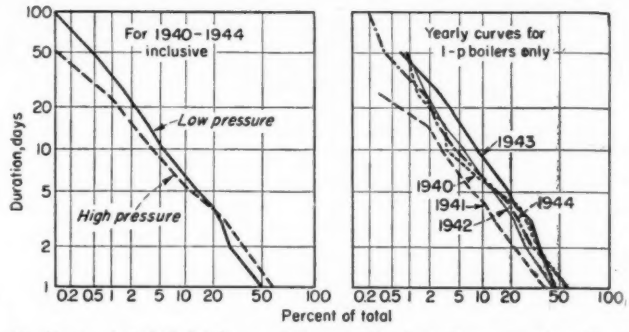
The terms of the expansion have the following meanings: *1st term*—expected fraction of time that no units will be on forced outage; *2nd term*—expected fraction of time that one unit will be on forced outage; *3rd term*—expected fraction of time that two units will be on forced outage; *4th term*—fraction of time that m units will be on forced outage; *last term*—fraction of time that all units will be on forced outage simultaneously.

For a group of n similar units, of c capacity each, of which m units are in reserve the outage probability in excess of the reserve is found by adding the probabilities from the above expansion of losing $m + 1$, $m + 2$, . . . n units. For a group of dissimilar units, divide

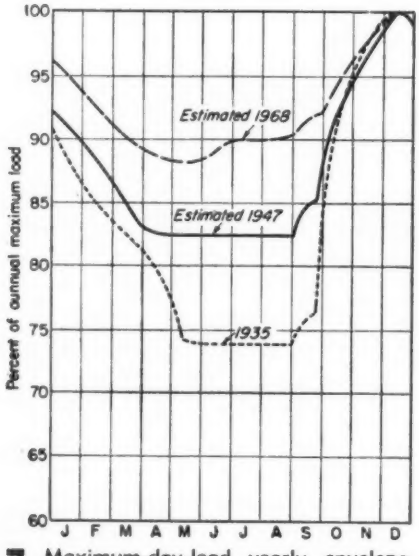
Probability Theory Can Predict Frequency of Future Events



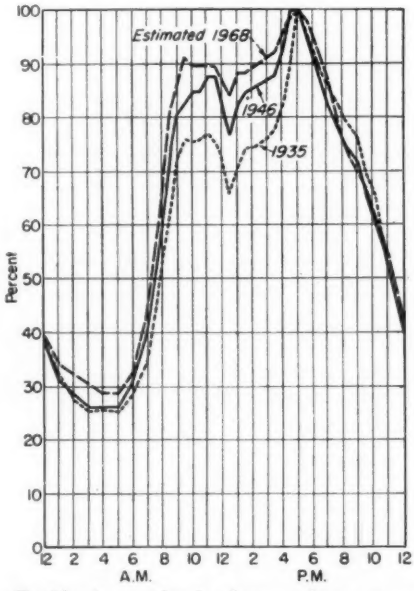
3 Percent total turbine outages with durations greater than indicated value by pressure class and by years 1939-44



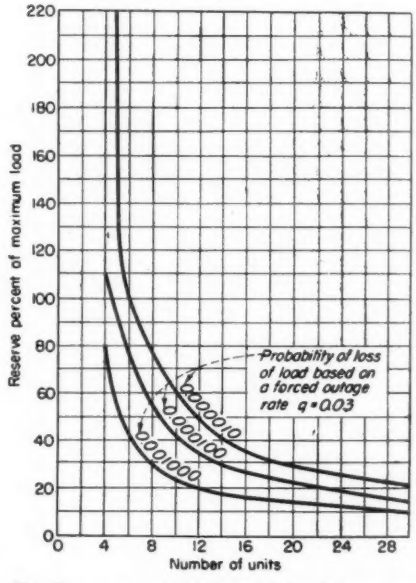
4 Percent total boiler outages with durations greater than indicated value by pressure classes and by years 1940-4



7 Maximum-day-load yearly envelope reflects maintenance - reserve need



8 Maximum-day load curve shows growing daily load factor on Con Edison


Probability of loss of load based on a forced outage rate q = 0.03
0.000010
0.000100
0.001000
Reserve percent of maximum load
Number of units

9 For any probability of load loss, reserve needed drops with added units

them into subgroups of similar units and calculate the outage probabilities of each subgroup, then combine the calculations for each subgroup as shown in Table I, p 104. From Table I a summary of outage probabilities in terms of mw out of service instead of number of units can be calculated as shown in Table II.

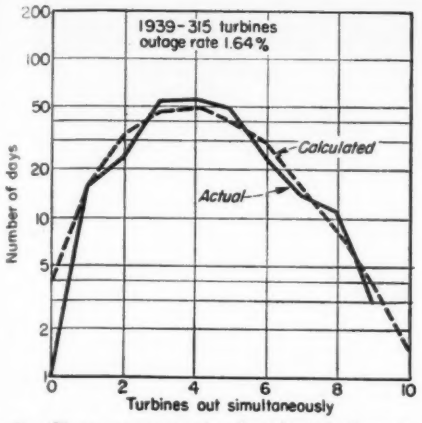
Results of such a study for the Consolidated Edison system are shown in Fig. 2. Curve *A* represents 60 units on the system in 1938 that aggregated 2592 mw with a turbine outage of 0.03, neglecting effect of boilers. Curve *B* represents expected experience for 1968 with estimated capacity of 3770 mw for the following outage rates: below 1000-psig pressure, turbines 0.01, boilers, 0.015; 1000 psig and above, boilers and turbines, 0.03.

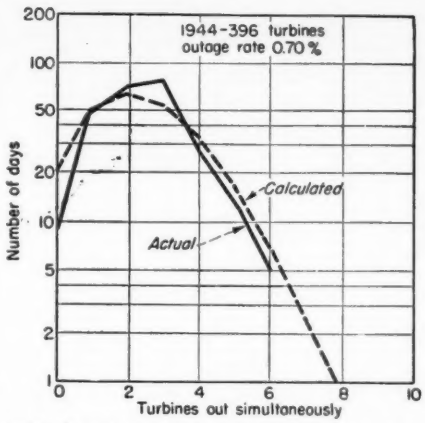
While these outages are expressed as a given fraction of time, they must not be interpreted to mean that this exact fraction will occur every year. Rather, over a long term of years the various values of outage time will average at the calculated magnitudes.

Outage Duration. Probability calculations give no information on the durations of individual outages. This can only be obtained from past experience. Fig. 3 and 4 summarize experience on a large number of units canvassed by the EEI. This type of information is of importance to the planning engineer, especially where hydro plants with storage reservoirs are involved.

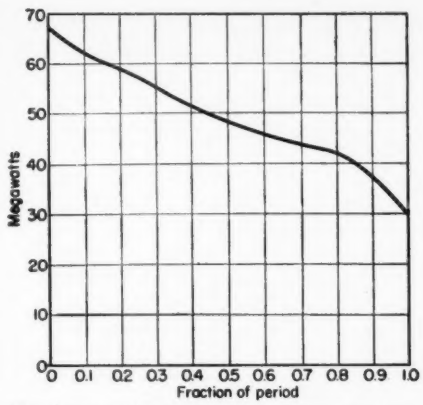
Once the outage rate is known it becomes possible by means of the binomial formula to calculate the expected duration of simultaneous outages. Validity of the method can be checked against actual experience as shown in Fig. 5. These curves demonstrate the adequacy of the method for use in engineering planning, provided the data are properly interpreted.

Loss of Load. Having calculated the mathematical relationship of outage magnitudes and their probability of occurrence, next step is to compute the probability of loss of load for a given system of reserve. This is done by appropriate correlation of the probabilities of outage (Fig. 2) with the load-duration curve (such as Fig. 6).

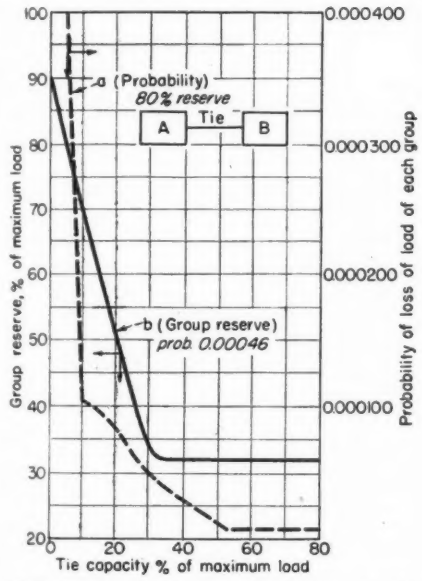




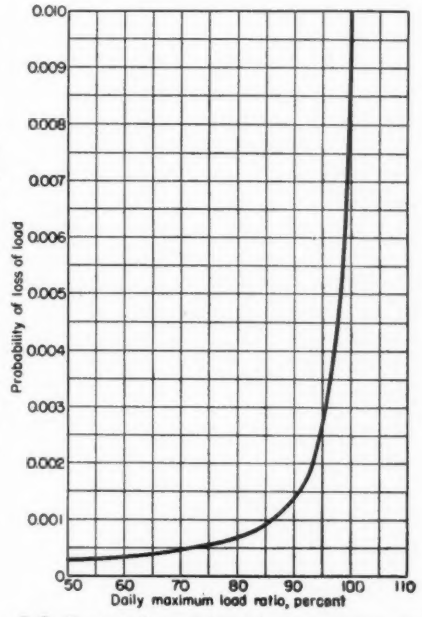
5 Close agreement of calculated and actual distribution of combination turbine forced outages validates use of prabability theory for engineering applications



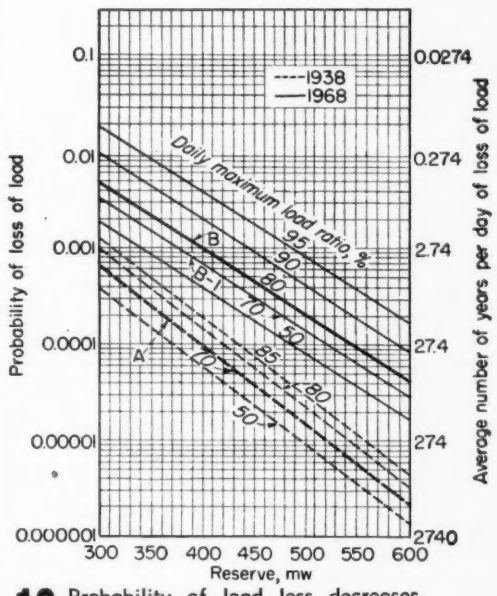
6 Annual load-duration curves are important in measuring unit outages



10 Tie capacity between stations markedly affects group reserve requirements



11 Probability of load loss increases at accelerated pace with daily load ratio



12 Probability of load loss decreases with growing system reserve capacity

For a discussion of this correlation see AIEE paper No. 47-248, "Generating Reserve Capacity Determined by the Probability Method," by G Calabrese.

Service Reliability. Having calculated the outage and load-loss probabilities, next step involves choosing a suitable index and fixing the value that will yield the desired degree of service reliability. These indexes can be expressed as: the number of days outage or loss of load per peak season or per year; as one day outage or loss of load in so many peak seasons; expected kwhr loss per peak season (or year) per kw of installed capacity; expected kwhr loss per year per kw of maximum load. The probability method assumes that the calculated outages can occur at any time of the year. But the peak load usually occurs at only one time during a year as shown in Fig. 6, 7 and 8; hence the probability of losing capacity in excess of the reserve at peak time is much smaller than if the peak load persisted throughout the year. On the other hand, equipment must be taken out of service over extended periods for overhauling, so that at times the reserve provided over the peak load is all that is available at lower loads. In view of these considerations it is recommended that the index of reliability be chosen with due regard to the nature of the load-duration curve and overhaul schedule. For a discussion of indexes see AIEE paper referred to previously in this article.

Level of Reliability. Level of reliability chosen depends on local conditions, importance of load, effect of voltage drop, size of system and, last but not least, personal judgment. A useful guide to selecting the level is past experience with outages and corrective measures that can be provided to reduce load when needed.

There are other problems that require evaluation of relative reliability of alternate methods of system development. The probability technique lends itself readily to arriving at an exact economic evaluation from this standpoint. Problems might be of the following nature: What reliability is lost or gained by decreasing or increasing system reserve? By changing the size

Table I: Array for Combining Outage Probabilities

Two Groups of Units: Three 15 Mw and Three 22 Mw. Outage = .03

Units	Mw	Probability	Units	Mw	Probability	Units	Mw	Probability	Units	Mw	Probability
Three 15-Mw Unit Group Separately											
0	0	.912673	1	15	.084681	2	30	.002619	3	45	.000027
Three 22-Mw Unit Group Separately											
0	0	.912673	1	22	.084681	2	44	.002619	3	66	.000027
Combined Groups											
0	0	.832972	1	22	.077286	2	44	.002390	3	66	.000025
1	15	.077286	2	37	.007171	3	59	.000222	4	81	.000002
2	30	.002390	3	52	.000222	4	74	.000007	5	96	—
3	45	.000025	4	67	.000002	5	89	—	6	111	—

Table II: Summary Probability of Outages For Groups of Three 15-Mw and Three 22-Mw Units

Mw	Probability of Outage: Exactly equaling indicated Mw	Exceeding indicated Mw
0	.832972	.167028
15	.077286	.089742
22	.077286	.012456
30	.002390	.010066
37	.007171	.002895
44	.002390	.000504
45	.000025	.000480
52	.000222	.000258
59	.000222	.000036
66	.000025	.000012
67	.000002	.000009
74	.000007	.000002
81	.000002	—
89	—	—
111	—	—

or point of connection of ties? By using a common steam header for a group of units? By interconnecting two systems? By changes in load factor?

Fig. 9 shows variation of reserve needs with the number of units of equal capacity and for three values of load-loss probabilities, and an outage rate of $q = 0.03$. Fig. 10 shows the effect of interconnecting two stations with a tie. Curve *a* gives the variation of load-loss probability of each station with the tie capacity, assuming local reserve at each station remaining constant at 80% of maximum load. Curve *b*, on the other hand, gives the local reserve needed to maintain load-loss probability at 0.00046. Both curves were figured for a load-duration curve shape of Fig. 6.

Fig. 11 shows the effect of variation in daily peak-load variations for a group of 60 units equivalent to those of the Consolidated Edison system in 1938. At that time the daily maximum load ratio = (sum of daily peak loads) 100/(Annual peak load × 365) was of the order of 70%. For an objective reserve of, say, 320 mw the load-loss probability was 0.00042. The curve shows, for instance, that with the same reserve if the ratio had been 80% the load-loss probability would rise to 0.000658, an increase of about 60%.

For constant conditions of load factor, outage rate and unit size, the degree of service reliability should be lower with increasing number of units. A given outage in excess of reserve becomes less severe as the system grows. Consistent with this criterion, the objective reserves of the major stations of the Consolidated Edison system as of 1938 were set to correspond to an expected outage in excess of reserve of one day every seven peak seasons. This compared with an expectancy of one day every peak season for the entire system.

Fig. 12 shows the combined effects of system growth and change in daily maximum load ratio on the load-loss probability of the Consolidated Edison system. The objective reserve for 1938 was 320 mw, corresponding to a load-loss probability of 0.00042 of 70% daily maximum load ratio. For 1968, with an expected daily maximum load ratio of 80% the reserve would be 455 mw for the same level of reliability as in 1938. Should the load ratio remain at 70% the reserve would drop to 430 mw. These figures represent contingency reserve requirements apart from considerations of overhauling.

Overhauling Units. The time available for periodic maintenance overhauls of generating units is determined by the amount of capacity represented by the difference in annual and daily peak loads, as shown by Fig. 7. Strictly speaking, the contingency reserve should be calculated, excluding the units on overhaul. For all practical purposes, considering the nature of the problem, it may usually be assumed that the contingency reserves remain constant through the year.

Regardless of the method used in calculating the reserve of a system, the final value must be checked to insure that it is sufficiently large to allow performing all extended maintenance work. Take into consideration the overhaul cycle and duration of both turbine-generators and boilers.

In 1938 the valley in the curve of daily maximum loads, Fig. 7, provided ample room for performing maintenance work. In addition, as a result of the depression, the actual reserve of the system exceeded the calculated value. During the war, and under the impact of the emergency, reserve standards were lowered and our actual reserves fell short of the value considered adequate. We are trying hard now to reestablish those standards, but because of the current shortage of materials and consequent delayed deliveries, we do not expect to do so for some time. Valley in the curve, Fig. 7, is gradually filling up so it is now anticipated that the long-range contingency reserve must be increased to fulfill overhauling requirements.

Conclusion. Though the method of probability has grown into a powerful tool for solving reserve problems, the applications made up to the present time have not exhausted its possibilities. The method can be further improved by using indexes of service reliability based on load-duration curves to include the effect of load variation. This purpose can be accomplished with little extra work by using straight-line curves and, usually, by replacing step outage-probability curves with approximate continuous ones, as in Fig. 2. The very nature of the problem entirely justifies these approximations without affecting the engineering accuracy of the results.

Consider These Factors in Specifying Mechanical-Drive Steam Turbines

Second article of a series by F S Kohl, turbine division, General Electric Co, reviews conditions that should be studied when considering installing mechanical-drive steam turbines

▶ PROPER APPLICATION of mechanical-drive turbines requires evaluation of various turbine characteristics and the conditions under which they operate. These factors are (1) ratings (2) speeds (3) steam conditions (4) efficiency (5) governing (6) special features and (7) accessories. The principles stated here provide a good background of information for proper turbine drives.

Since standard designs offer great advantages to the user in initial cost, shipment, stocking of spare parts, etc, they should be applied whenever possible. Where standard designs are not adequate, however, modified standard units or special designs covering a great variety of requirements are available.

Ratings and Speeds. Range of horsepower and speed ratings are almost limitless. Capacities range from less than 5 to more than 25,000 hp and speeds from less than 1000 to over 12,000 rpm. Speed-reduction gears extend the lower limit to below 200 rpm, while speed-increasing gears raise the upper limit to exceed 40,000 rpm.

All ratings are not normally available at all speeds as applications do not call for all possible combinations. For example, it would be very unlikely to find a piece of driven equipment rated even 10,000 hp operating at speeds over 4000 rpm. Flexibility of turbine and gear design, however, can meet any application requirement.

The great majority of applications need less than 800 hp with speeds below 4500 rpm. Most of these can be met with standard units and almost "off-the-shelf" design. Semi-standard designs, using standardized components cover the bulk of the remainder.

Steam Conditions. Mechanical-drive turbines are built for a wide range of steam conditions.

Initial pressure, less than 50 to over 2000 psig.

Initial quality or temperature, 3% moisture to 1050 F.

Backpressure, 1 in. Hg to over 400 psig.

Standard designs are suitable for initial conditions up to 600 psig, 750 F, and with backpressures up to 75 psig. Semistandard designs range up to initial conditions of about 1200 psig, 950 F and backpressures up to 250 psig.

Efficiency. One of the most important points considered will be efficiency desired. For given horsepower, speed and steam conditions, any one of several designs can be used.

From an efficiency standpoint, the decision on design should be based upon a cost study. But experience provides some approximate rules of thumb that can be used in the majority of cases. Table I summarizes the most usual turbine selection after cost studies for given operating conditions.

Another consideration in efficiency is the question of geared vs direct-connected drive. Speed of the driven equipment is the most important factor in this selection, although rating and steam conditions have considerable effect.

Turbines are inherently high-speed machines, low turbine speed sacrifices economy. If the driven equipment op-

Table I: Guide to Most Likely Turbine For Given Application Conditions

CODE DESIGNATION
A: Single-stage, small wheel
B: Single-stage, large wheel[1]
C: Multistage, low efficiency
D: Multistage, medium efficiency
E: Multistage, high efficiency

Rating	Load Factor[2]	Condensing Cost of Steam High	Condensing Cost of Steam Low	Noncondensing Cost of Steam High	Noncondensing Cost of Steam Low
Less than 200 hp	Low	B	A	A	A
	Medium	*	B	B	A
	High	*	*	B	A
200–500 hp	Low	C	B	B	A
	Medium	D	C	C	A
	High	E	D	D or E	B
500–1000 hp	Low	C	C	C	B
	Medium	D	C	D	B
	High	E	D	E	C
1000–2000 hp	Low	C	C	C	B
	Medium	D	D	D	B
	High	E	E	E	C
Over 2000 hp	Low	D	D	D	C
	Medium	E	E	E	D
	High	E	E	E	E

[1]Larger sizes usually give higher efficiency.
[2]Low—standby service, medium—about 50%, high—base loaded.
*Usually not a good turbine application.

erates at relatively low speeds, geared turbines should be considered, as they usually offer tremendous improvements in economy. Listed below are speeds generally considered as the lowest minimum acceptable in average applications where efficiency is not highly evaluated:

Hp rating	*Approximate minimum "direct-connected" speed, rpm*
50	1000
400	1500
1000	2000
2000	2500

Naturally, these limits will be higher whenever economy is more important.

Partial-Load Economy. Efficiency at part load may be of considerable importance. This item should be studied after fixing the desired level of efficiency. On most small turbines a single valve controls the steam flow to the total area of first-stage nozzles. At light loads, the full throttling causes considerable energy loss. By sectionalizing the first-stage nozzles and controlling each section with a separate valve, either by hand or automatically, the throttling loss reduces. The importance of decreasing this throttling loss depends on the application. In noncondensing units where the demand for exhaust steam exceeds the amount furnished by the turbine, increased efficiency has practically no value. Where throttling causes heat loss to the over-all cycle, however, as in condensing applications, the added valving has considerable value.

While hand-valve arrangements are inexpensive, they have doubtful value with rapid or frequent load swings. Operators must change the settings with every sizable load change in order to realize a gain. Automatic sectional valves are comparatively expensive for small units, not being used normally for ratings less than 500 to 600 hp. Above these ratings automatic sectional valves become increasingly important.

Cost of Steam. In making any study to determine efficiency, load factor and steam cost are of greatest importance. Load factor can usually be established with fair accuracy. Computing the cost of steam may not be as easy. Cost at the boilers is usually known. When the heat divides between power generation and process requirements, however, computing the cost becomes difficult. This is particularly true when the division of heat varies on irregular swings.

In the simplest case where all the flow for process always passes through turbines, an approximate division of 15% power and 85% process can be applied to the cost of steam at the boilers. In such cases, steam cost chargeable to the turbine may be a small percentage of the total steam cost. A careful study of this situation is recommended.

Other Factors. Factors other than turbine cost may influence an installation decision. For example, if a unit is to be installed in a location needing a long run of pipe, either inlet or exhaust, cost of the larger pipe required to handle the increased flow of a less efficient unit may outweigh the lower cost of such a unit. Or, the need for low exhaust temperature may dictate the selection of a more efficient unit.

Governing. Speed-governing systems used on mechanical-drive turbines range from simple direct-acting flyball governors, through hydraulic governing systems, to the highly accurate, long-range electrical type.

Most governor designs are arranged so that pressure regulators can be applied to control speed in response to remote signals, such as pump discharge pressure, differential pressure across feed valves, combustion requirements, temperature, etc. Through the use of regulators, turbine control is very flex-

(*Continued on page* 140)

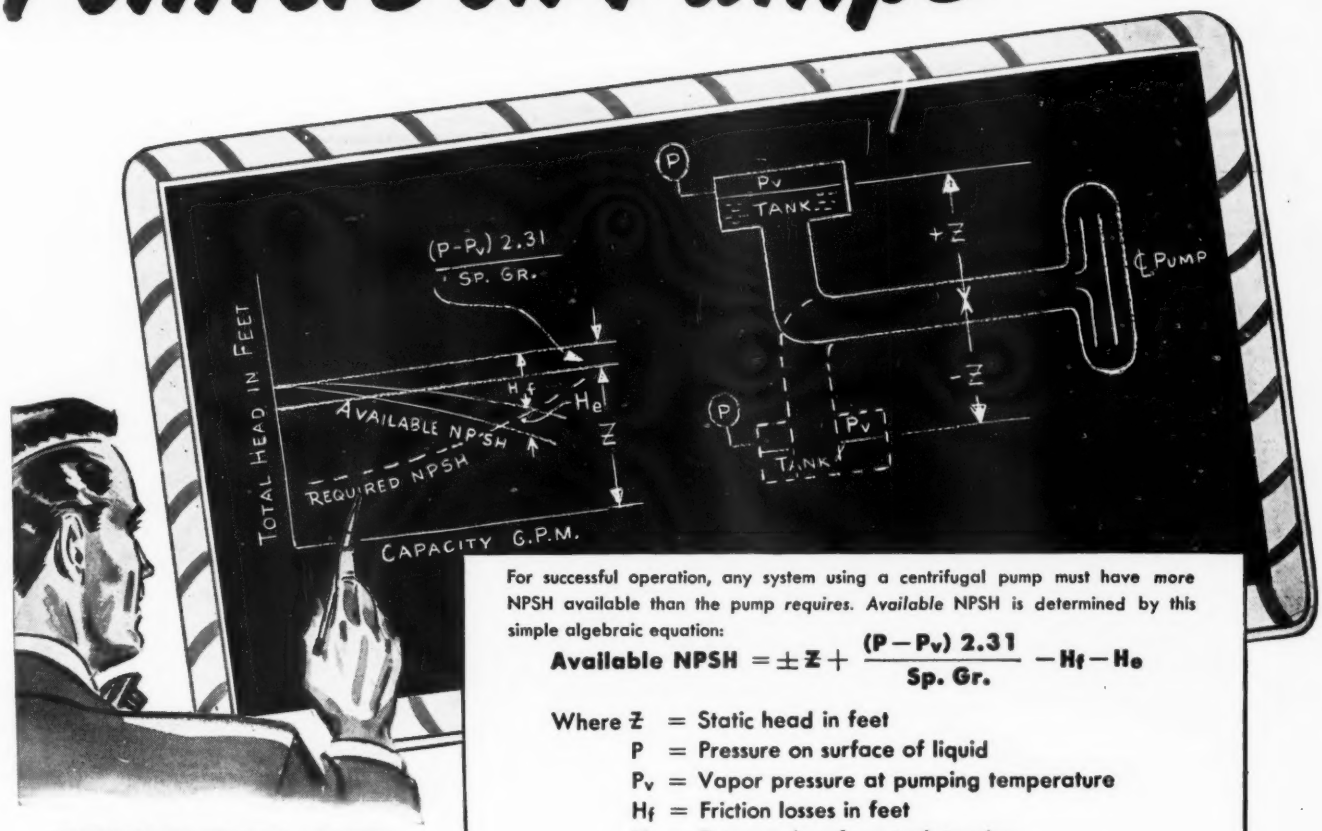
Table II: Special Features Modify Basic Standard Designs

Feature	Purpose	Remarks
Pressure regulator	To keep pump pressure constant, or hold constant excess pressure by regulating turbine speed	Used for most pump applications particularly boiler feed pumps. Can be used to keep turbine on automatic standby service
Temperature controller	To hold constant temperature by regulating turbine speed	Used for refrigerator compressor drive control
Backpressure governor	To hold pressure in exhaust line constant by changing steam flow	Can be used on dual-drive applications where speed is held by motor
Equipment for condensing operation	To provide steam sealing on noncondensing units when operating condensing	Single-stage units are basically noncondensing; for condensing operation this feature must be added. Commonly used on units for standby service or for summertime condensing operation
Lubricating oil for driven equipment	To provide oil under pressure for bearings of pump, fan or for control device	Frequently saves adding oil pump to driven equipment
Remote speed control	To control motor-driven speed changer	Convenient, a timesaver
Preset speed control	To provide momentary contact pushbutton control for automatic speed setting	Used for washing speed and full speed on paper machine drives to save time
Tripping devices	To provide automatic or remote control of shutdown devices	Additional safeguards for emergency conditions
Solenoid inlet valve	To provide for automatic quick starting	For emergency standby units
Breakaway valve	To provide high steam flow for extra high starting torque	Used on drives for equipment with high inertia

Table III: Accessories Available For Mechanical-Drive Turbines

Accessory	Remarks
Instruments	Gages, thermometers, tachometers, barometers, etc
Base	Often furnished by manufacturer of driven equipment
Jackshaft	For belt drive
Flexible couplings	Purchase through turbine manufacturer may prove convenient
Low oil-pressure trip	Added protection against loss of oil pressure
Relief valves	Primary protection against overpressure in casing
High backpressure trip	Added protection against overpressure in casing
Oil filters, purifiers, and special coolers	Keep oil clean and cool under adverse conditions
Auxiliary oil pump	For standby and starting service
Insulation or lagging	Saves heat, improves appearance
Coupling guards	Safety guard

Pointers on Pumps



For successful operation, any system using a centrifugal pump must have *more* NPSH available than the pump *requires*. *Available* NPSH is determined by this simple algebraic equation:

$$\text{Available NPSH} = \pm Z + \frac{(P - P_v)\ 2.31}{\text{Sp. Gr.}} - H_f - H_e$$

Where Z = Static head in feet
P = Pressure on surface of liquid
P_v = Vapor pressure at pumping temperature
H_f = Friction losses in feet
H_e = Entrance loss from tank to pipe

NOTE: For boiling liquids, P usually equals P_v; this item is therefore omitted from the problem.

WHAT IS NPSH?

NPSH (net positive suction head) is an *absolute* term covering hydraulic conditions at the suction side of a centrifugal pump. It can be used instead of the *relative* terms "suction lift" and "suction head" to assure the proper application of centrifugal pumps. These relative terms are useful in calculating the total head against which the pump must operate; but they should not be used when considering the suction condition as it affects proper centrifugal pump selection.

Actually, every centrifugal pump has its own NPSH characteristic, usually referred to as "required NPSH" The pump impeller opening must be filled at the required rate of flow (GPM) so the impeller can pump at this rate. The velocity needed to put this quantity into the impeller opening must come from an external head. The value of this external head is the "required NPSH".

Obviously, if the liquid pumped is not to vaporize in the entrance to the impeller, the required NPSH must be measured over and above the vapor pressure of the liquid at the pumping temperature. The required NPSH will vary roughly as the square of the pump capacity through the useful range of application of that pump.

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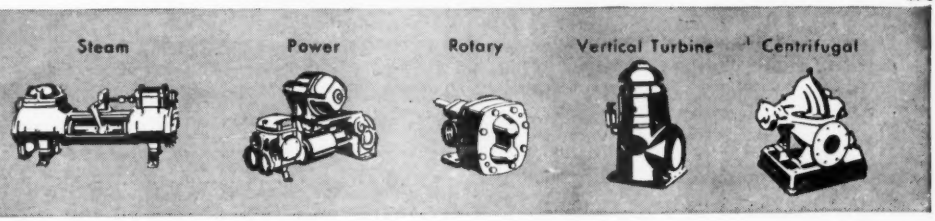


CS-8

ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*

4—Tube Types in Everyday Use

Fourth in a series of easy lessons telling what electrons are, the different kinds of tubes in common use and how they are adapted as power rectifiers, amplifiers, controllers and frequency changers in a wide variety of circuits.

▶ ELECTRON TUBES are of many designs for almost countless purposes, but a comparatively few do most of the jobs for industrial-electronic circuits. Here we will study the commonly used types.

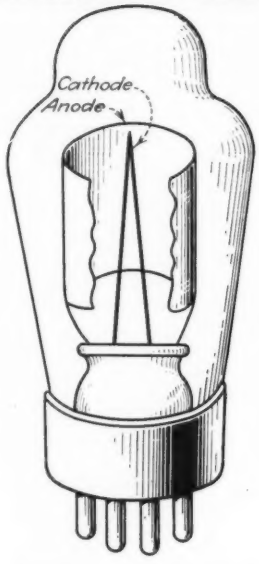
In its simplest form an electron tube has two elements: filament or cathode and plate or anode, Fig. 1. Such a tube is known as a diode, meaning it has two elements: The directly heated cathode, the electron-producing element, takes the form of a wire loop whereas the anode, the electron-collecting element, is a metal cylinder. These two parts connect to terminals in the base, arranged to fit into a suitable socket.

For simplicity, our diagrams use symbols for electron tubes connected in circuits. Fig. 2 shows the symbol for a 2-element high-vacuum tube with directly heated cathode, Fig. 1. If we connect a battery *A* of about 5 volts across the cathode, Fig. 4, current flows through it as the arrowheads indicate. This current heats the cathode to a high temperature where it emits electrons into space as shown.

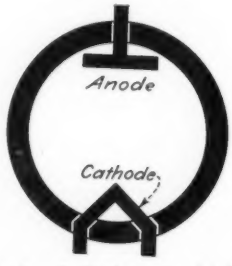
Heating the cathode boils electrons off its surface much as steam boils off water when heated to boiling temperature. Since the anode is at zero potential most of the electrons come back to the cathode, for two reasons: (1) When the cathode loses electrons, it tends to become positively charged and attracts electrons back to it. (2) Some electrons emitted into space form a negative space charge that repels other electrons and drives them back to the cathode.

If we connect the anode to the positive terminal of the battery, Fig. 5, the plate is given a low positive potential so

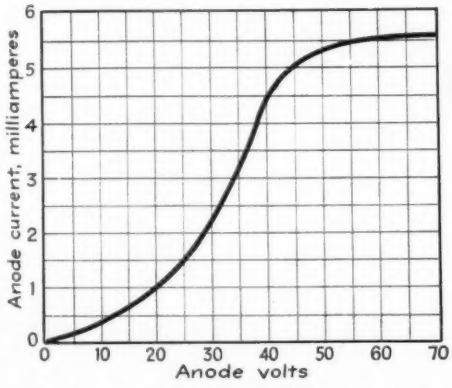
Two-Element Tubes



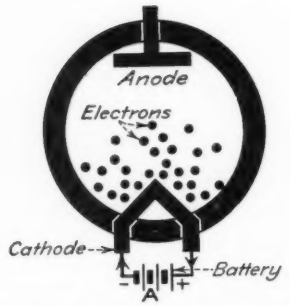
1 This two-element high-vacuum tube has anode and direct-heated cathode



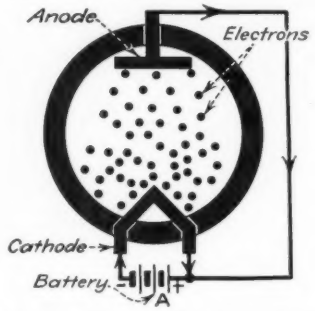
2 Symbol of 2-element high-vacuum tube with direct heated cathode



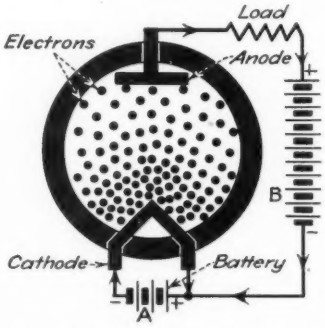
3 Curve of the current flow through a 2-element high-vacuum electron tube



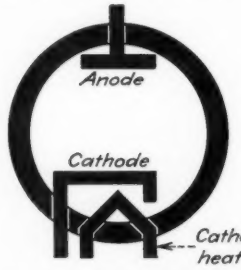
4 The cathode of high-vacuum tube is heated to cause it to emit electrons



5 Low voltage, applied to the anode, will cause a small current to flow



6 Adding battery B in anode circuit increases the flow of the current

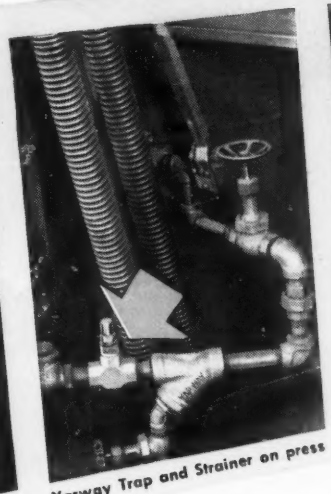


7 Symbol of 2-element vacuum tube with cathode that is indirectly heated

115 *Yarway Impulse Steam Traps and Strainers at NASHVILLE'S LEADING LAUNDRY PROVE "HIGHLY SATISFACTORY WITHOUT EXCEPTION"*

A CLEAN RECORD!

Yarway Trap and Strainer on tumbler


Yarway Trap and Strainer on press

Interior of Hermitage Laundry

Hermitage Laundry at Nashville, Tenn.—one of the South's most modern plants—first used Yarway Impulse Steam Traps to correct trouble experienced with other type traps, such as slow heating of equipment. Yarways proved outstandingly successful. Many have been in use over 18 months, giving trouble-free service.

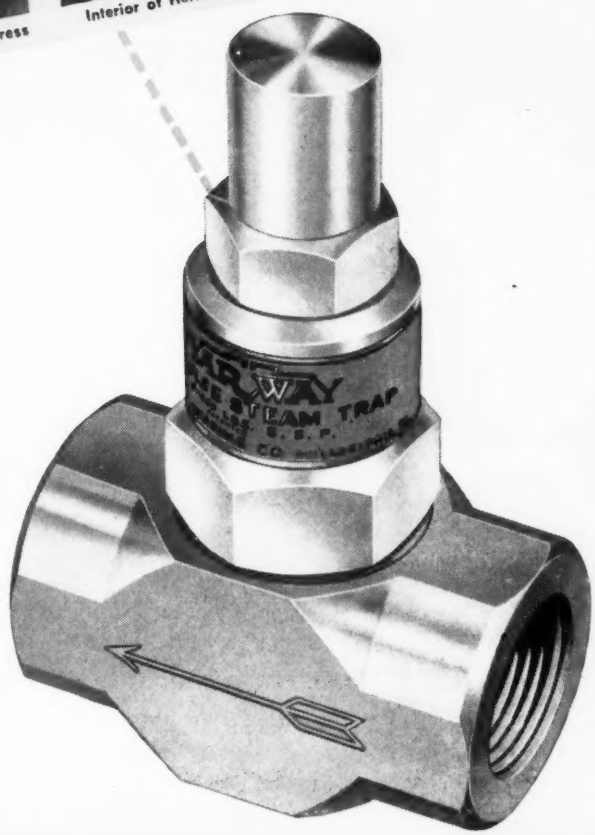
All equipment at Hermitage—both old and new—is now Yarway-trapped. In all, 115 Yarway Traps, each with a Yarway Strainer, are getting this equipment *hotter, sooner—and keeping it hot!*

More and more plants in the laundry and dry cleaning industries, as well as other industries where steam equipment is used, are adopting the Yarway Impulse Steam Trap because of these obvious advantages—*small size, quicker heating, easy maintenance* (*only one moving part*), *low cost.*

Nearly 600,000 have already been bought!

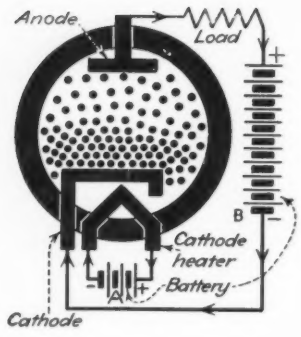
ORDER YARWAY TRAPS AND STRAINERS FROM YOUR NEAREST MILL SUPPLY DEALER. FOR NAME AND FREE TRAP BOOKLET, WRITE . . .

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.

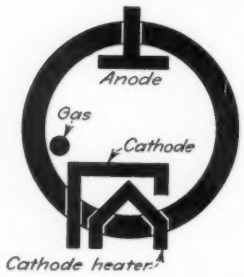


YARWAY IMPULSE STEAM TRAP

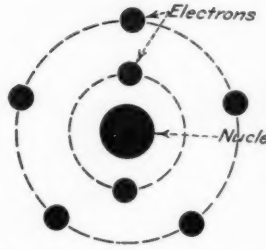
Gas-Filled and Grid Tubes



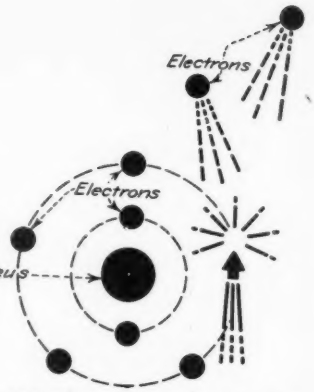
8 Battery B is connected to the anode and the cathode



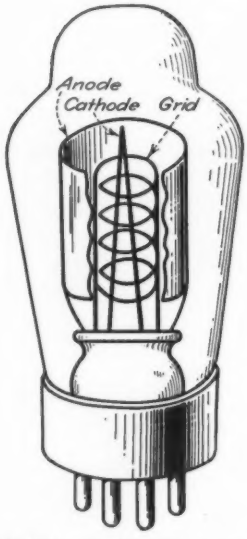
9 The symbol of a 2-element tube which is gas filled



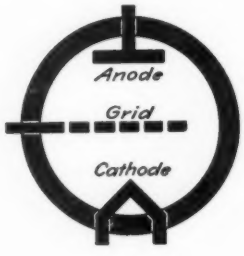
10 Gas atom before it has been hit by an electron



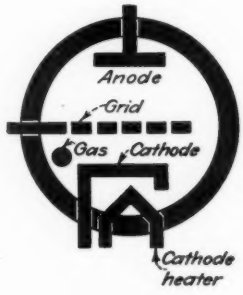
11 Gas atom after it has been hit by an electron



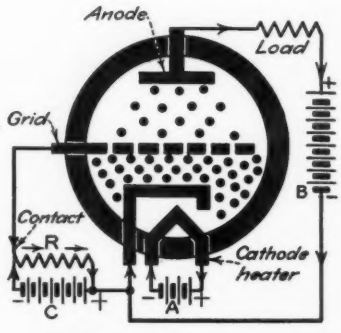
12 This 3-element vacuum tube has a control grid



13 The symbol of 3-element vacuum electron tube



14 The symbol of 3-element tube that is gas filled



15 Diagram of vacuum tube that is grid controlled

it attracts some of the negative electrons given off by the cathode. As a result a small current flows from the anode to the + terminal of the battery, through the battery to the cathode and to the plate.

Connecting a battery *B*, Fig. 6, in the anode circuit increases the positive potential on the anode and increases the flow of electrons from the cathode, that is, increases the current flow through the tube.

Not all the electrons emitted by the cathode reach the anode. Some return to the cathode while others remain in space between cathode and anode for a short time to produce an effect known as a space charge. As mentioned, this space charge tends to repel other electrons that leave the cathode and impede their movement to the anode.

How much this action may retard flow of electrons, and consequently current flow through the tube, depends on cathode temperature and anode potential. The higher we make the anode potential the fewer electrons remain in the space charge to repel others.

If we increase the anode potential by adding cells to battery *B*, Fig. 6, the anode is made more positive and attracts a greater number of free electrons. In other words, current flow through the tube increases.

Fig. 3 shows approximate current flow through a high-vacuum 2-element tube when cathode current is held constant and anode voltage gradually increased. At first, current rises slowly, then rapidly, after which the rate of increase decreases until a point is reached beyond which the current remains practically constant. This is known as the saturation point.

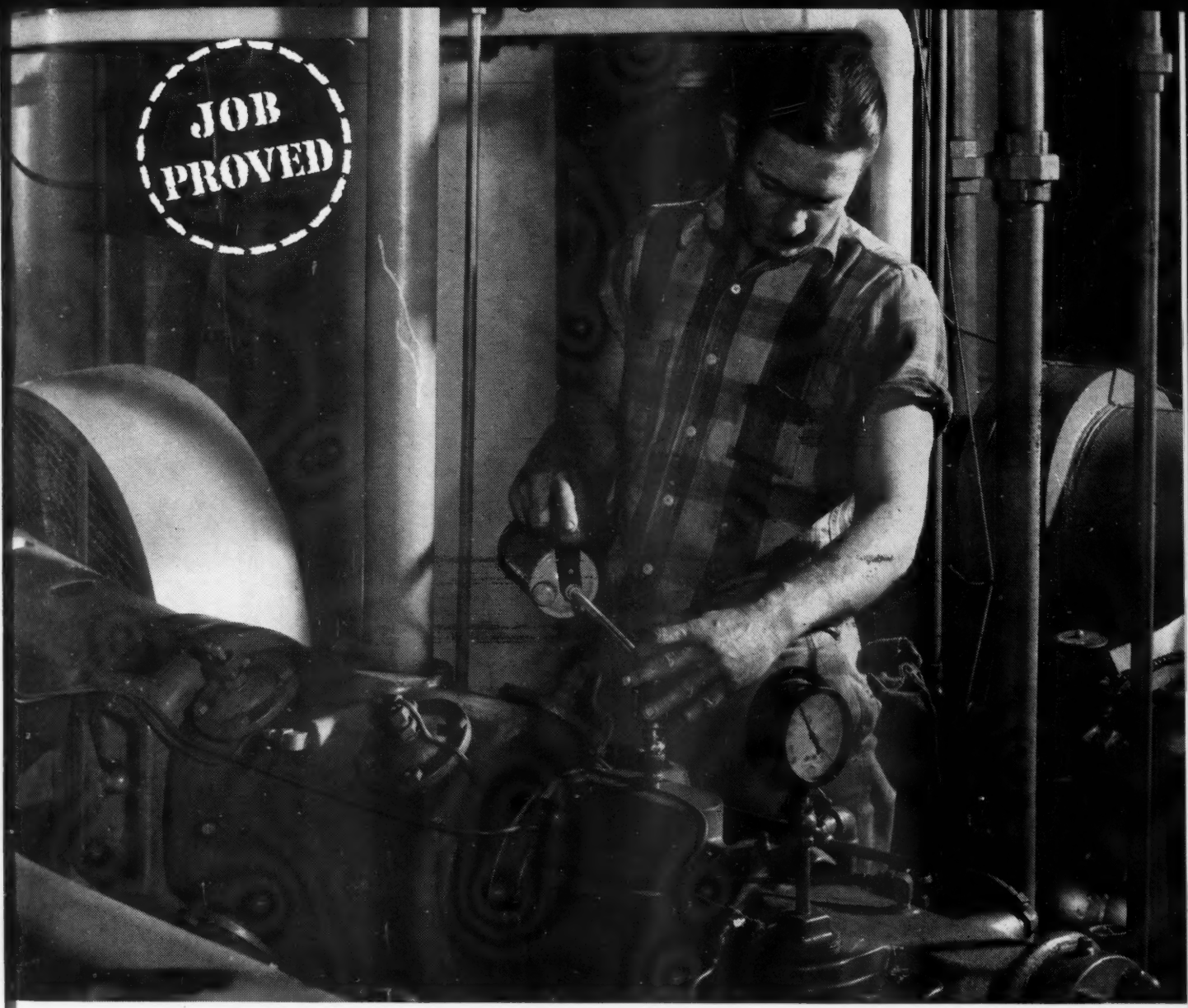
If, after saturation is reached, we increase the cathode voltage, its temperature increases, causing an increase in cathode electron emission and current flow through the tube. Thus, current flow through a 2-element tube may be increased by increasing cathode or anode voltage within the safe limits of the tube. Generally, current flow is controlled by changing the anode voltage.

Amount of current flowing through a high-vacuum tube depends on the size of cathode and anode, their design, cathode temperature, anode voltage, distance between cathode and anode, and other factors. In some tubes with an indirectly heated cathode, anode and cathode are spaced only 0.02 in. apart.

Fig. 7 shows the symbol for a tube with an indirectly heated cathode, which is the same as Fig. 2 except the cathode is separate from the heater element. This, however, does not complicate the tube circuits because, as shown in Fig. 8, the circuits are the same as in Fig. 6, except electrons flow from the cathode instead of, directly from the heated filament.

A high-vacuum tube has an absolute pressure of only about three ten-millionths of an inch of mercury. To increase current flow through electron tubes many of them contain a small amount of mercury, which is partly vaporized when the tube is in operation. Other tubes contain an inert gas at an absolute pressure of around three to five one-hundredths of an inch of mercury.

This gas fills the space in the tube with atoms, which are very large compared to the electrons. As explained in the first article (POWER, April, p 105) each atom consists of a positive nucleus with a number of electrons rotat-



UNDER PRESSURE 11 YEARS...STILL GOING STRONG

A Sun Oil Helps Keep Compressor on the Job 16 Hours a Day—No Hard Carbon Forms

The "lungs" of a forced ventilation system in a large industrial plant are two-stage air compressors—pumping air through the system at 300 pounds per square inch.

One of these compressors, now over 11 years old, has been running 16 hours a day since its installation. From the start, a Sun lubricant has been used to lubricate crosshead and air cylinder. During the past five years there has been but one shutdown . . . and that occurred when a different brand of oil was used by mistake!

Operating on the Sun lubricant, the compressor is running as well today as ever. No hard carbon has formed. As a result of this record the plant has standardized on Sun lubricants for all its air compressors and vacuum pumps.

This performance is typical of the advantages gained from "Job Proved" Sun lubricants in thousands of industrial plants. Further information can be had from any Sun Office. For a copy of the booklet "Lubrication of Air Compressors and Pneumatic Tools" write Department P-7.

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ing about it, Fig. 10. In a normal atom, negative electrical charges of electrons equal positive charges on the protons in the nucleus, so the atom is electrically neutral.

When an electron emitted from the cathode at high velocity collides with a gas atom the impact knocks one or more electrons out of the atom, Fig. 11. In a gas-filled electron tube that is in operation, a tremendous number of gas atoms are being bombarded by the electrons shot out into space by the hot cathode. As a result the number of free electrons is greatly increased in the space between cathode and anode.

Atoms that lose one or more electrons become positively charged, because the negative charge of their electrons is less than the positive charge of their nucleus. These positively charged atoms are called ions and the process of forming them is ionization.

The positive charge on the ions neutralizes most of the negative space-charge effects existing in a high-vacuum tube, and permits more electrons to reach the anode. This effect, combined with a large increase in free electrons, previously mentioned, results in a large increase in current flow through the tube compared to a high-vacuum tube under similar conditions.

In Fig. 9, the symbol for a gas-filled tube is the same as for the high-vacuum tube in Fig. 7 except that it contains a large dot. This dot represents inert gas, or a drop of mercury that partly vaporizes when the tube operates.

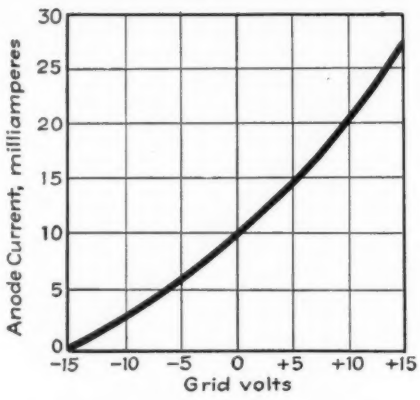
All electron tubes are essentially rectifiers; that is, they let current flow through them in one direction only. This characteristic permits using them to change alternating to direct current, which will be explained in later articles.

A simple diode, 2-element electron tube, has no means of controlling current flow through it except by external means, as explained. To make it possible for electron tubes to control current flow through them a third element, or grid, is added, Fig. 12. Such a tube is called a triode and its grid is placed between cathode and anode as shown. In Fig. 12 the grid connects to a terminal in the tube base. In other designs, this connection is placed in the side of the tube. Grids differ in both form and material (Fig. 25 to 29, POWER, June, pp 98, 100) depending on tube design, size and application.

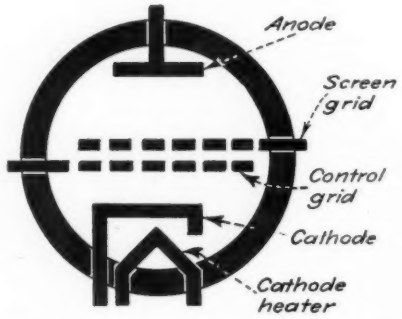
Fig. 13 shows the symbol for a grid-controlled high-vacuum tube with a directly heated cathode, and Fig. 14 for a grid-controlled gas-filled tube with an indirectly heated cathode. Fig. 15

(*Continued on page* 142)

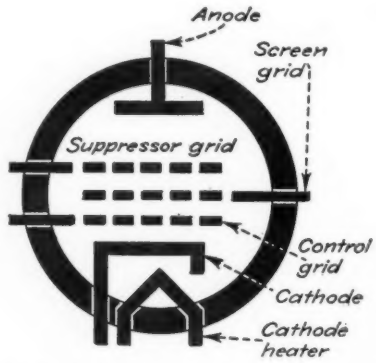
Hot and Cold Cathodes



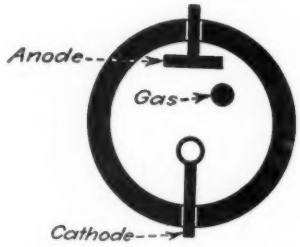
16 Current change made by adjusting potential on grid of vacuum tube



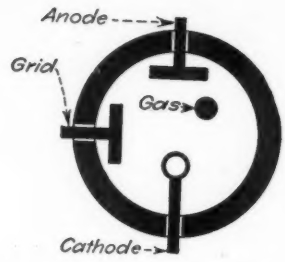
17 The symbol of a high-vacuum tube with both control and screen grid



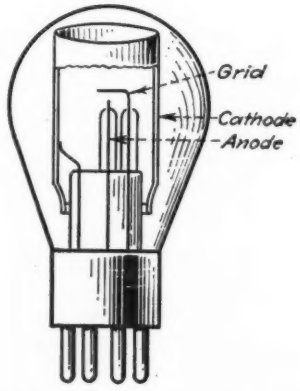
18 Symbol of a five-element tube with cathode that is indirectly heated



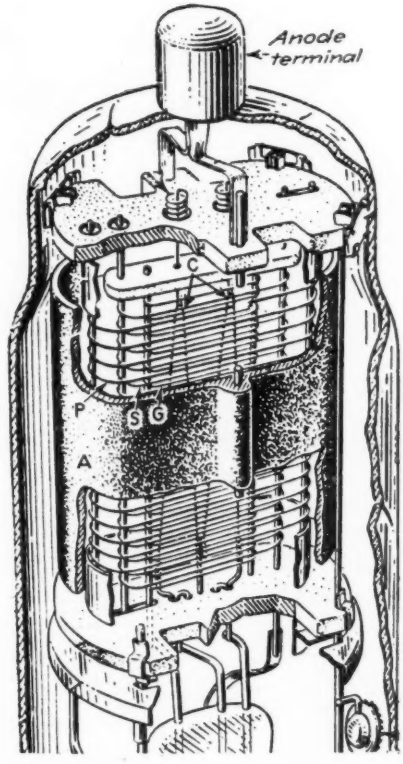
19 Symbol of a gas-filled two-element electron tube of cold-cathode type



20 The symbol of a grid-controlled gas-filled cold-cathode electron tube



21 One design of cold-cathode electron tube that is controlled by a grid



22 Arrangement of the elements in one design of tube having five elements

Achilles Heel

...INDUSTRIALLY SPEAKING

Legend tells of the supposedly indestructible Achilles and how finally he was slain when an arrow found its mark in his only vulnerable spot—his heel.

Too often in industry today, Production's vulnerable spot is the boiler plant . . . a boiler plant made unprofitable by improper water conditioning.

Correct water conditioning is a matter of careful and scientific control.

W. H. & L. D. BETZ is an organization of engineers and chemists specializing in the solution of all industrial water problems. Years of experience have made Betz water conditioning service scientifically correct . . . complete . . . economical. Our staff of engineers will welcome the opportunity of discussing your boiler water problems . . .

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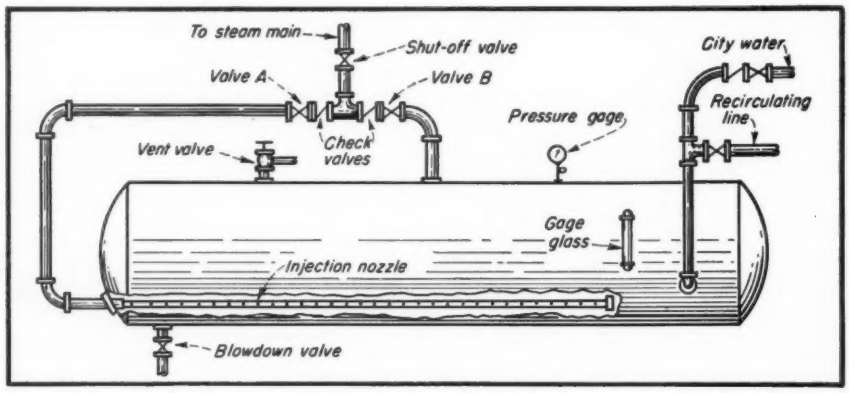
POWER ENGINEERS' NOTEBOOK

PLANT-TESTED IDEAS TO SOLVE PROBLEMS OF DESIGN, OPERATION AND MAINTENANCE



ACCUMULATOR HELPS CARRY PEAK LOAD

DURING THE WAR our plant lacked boiler capacity so it was a case of using what we had to best advantage. Our normal steady load gave no trouble but the peak loads were hard to satisfy. We had four large vulcanizers operating 24 hr a day, two were 5 ft dia x 25 ft long, one was 6 ft dia x 15 ft long, and the other 4 ft dia x 25 ft long. At the end of each curing cycle the vulcanizers and their charge were cooled by pumping in city water. The cool-down period lasted from 30 to 45 min., bringing the shell temperature to within a few degrees of water temperature.

The reloaded vulcanizer would then have its temperature raised from about 50 to 295 F, which was maintained during the curing period. This created a high steam demand at the start of each cycle. We staggered the curing-cycle starts but found that production rate could not be kept at a high level. The boilers needed about 45 min to reestablish pressure for the start of the next curing cycle.

Our steam equipment consisted of two 300-sq ft gas-fired automatic immersion-type boilers operating at 95 psig. Electrically driven centrifugal pumps fed the boilers with treated city water.

To satisfy peak demands and eliminate delayed starts we installed an accumulator. Maximum loads were handled easily and curing cycles could be started within 12 min of each other. The accumulator was a second-hand boiler drum, about 5 ft dia and 15 ft long. Very few changes were needed in its adaptation to this service. A new injection nozzle was installed that extended about three-quarters of the drum length and had ¼-in. holes on 4-in. centers drilled along its length. The end was capped and also drilled. The holes were in a horizontal position.

A gage glass was put on the side of the drum with water showing 1 in. above the packing nut when the drum was half full. A fitting near the gage glass tied in the water inlet and recirculation line. The drum was suspended from its saddles in a steel framework.

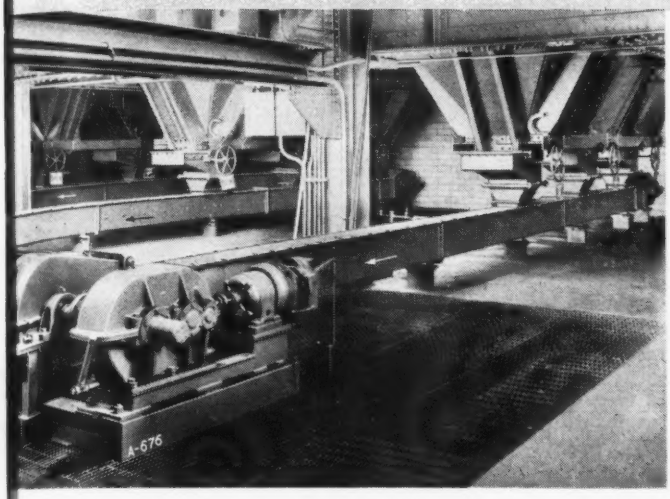
Placing the accumulator in operation was preceded by washing out the drum and calling in the boiler inspector. After necessary approvals the drum was half filled with fresh water. Opening steam valve *A* allowed steam to enter through the injection nozzle. The vent valve was kept open until steam showed. When the pressure rose to about 10 psig, valve *B* was opened. In

NYLON BRUSHES CLEAN CONDENSER TUBES

A TWO-YEAR TEST, under varying conditions, of nylon spiral brushes shot through condenser tubes demonstrates that they do a more thorough cleaning job than other methods of mechanical cleaning that have been tried at the test plants. This has been reflected in a reduction of outage time caused by main condenser cleaning. Examination of condenser tubes shows that the brush does not roughen and scratch the interior surfaces as it passes through.

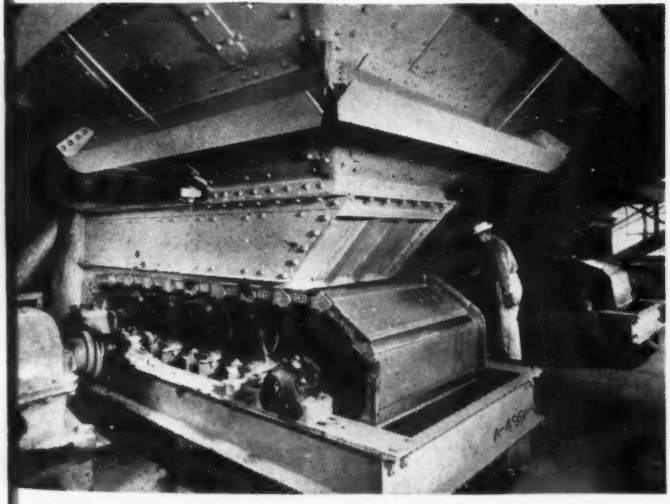
Brushes are about 4 in. long with diameters varying according to the tubes they are to be used in. A special cone-shaped steel washer, slightly smaller than the inside diameter of the tube is welded to the wire stem at the trailing or pushing end of the brush. The brushes were jointly developed by L E Hankinson, West Penn Power Co, and the Osborn Manufacturing Co.

Specific Advantages, Lower Costs, are Yours with S-A Bulk Material Handling Systems

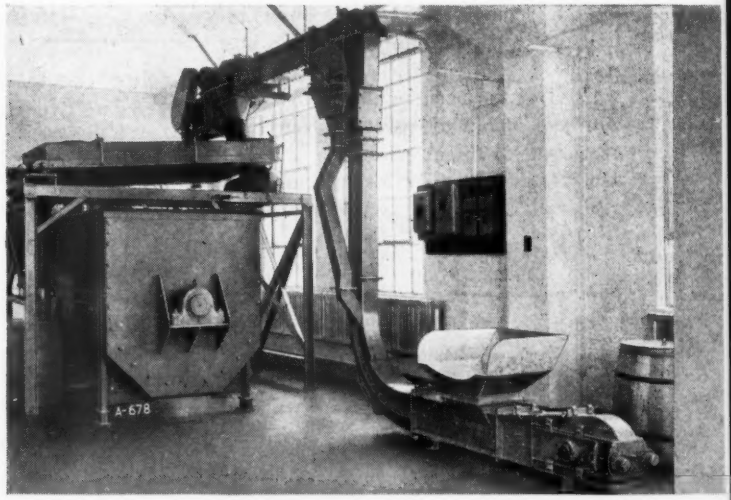


AUTOMATIC CONTROL of coal handling from bunkers to pulverizers at this large generating station is made possible with REDLER conveyors. Eight horizontal REDLERS withdraw coal from storage bunkers. Dust-tight casings prevent escape of coal dust. Installation required only small amount of space due to compact REDLER design. Enclosed, dust-tight gates on bottom of bunkers were also built by S-A. Write for information on S-A equipment for handling coal at lowest cost.

UNUSUAL PROBLEMS are solved by S-A engineers. Here, a belt conveyor was installed to economically load bulk stone from a nearby quarry into river barges. S-A "Pacific" carriers with pressure-lubricated Timken roller bearings assure lowest maintenance cost. Carriers are of heavy gauge steel with malleable iron end stands. Barge is moved slowly past end of conveyor while stone is piled to uniform height. Write for data on S-A belt conveyors for moving required volumes of any bulk material.



LOWEST MAINTENANCE—Economical handling of over 5 million tons of ore in seven years was made possible by AMSCO manganese steel pan feeders. Durable, extremely tough manganese steel construction, combined with carefully engineered design, makes this S-A AMSCO feeder the best equipment available for this kind of heavy work. Feeders handle crushed ore from 500-ton capacity surge bin to two double-deck screens. Write for full information on how to handle large volume at lowest cost with S-A equipment.



PROTECT PRODUCT PURITY—Preventing contamination is of prime importance in this modern food plant, where a Z-type REDLER conveyor-elevator handles pastry mixes. Sealed casings also prevent spillage. Compact REDLER design combines elevator and conveyor in one unit. Ingredients are fed into hopper at right, elevated and conveyed to sifting screen, and discharged into mixing machine. Write today for latest data on S-A conveyor systems for food products.

STEPHEN S-A ADAMSON MFG. CO.

5 RIDGEWAY AVENUE, AURORA, ILLINOIS · LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of

BULK MATERIAL HANDLING EQUIPMENT

about an hour and a half the pressure rose to 85 psig with 95 psig at the boilers.

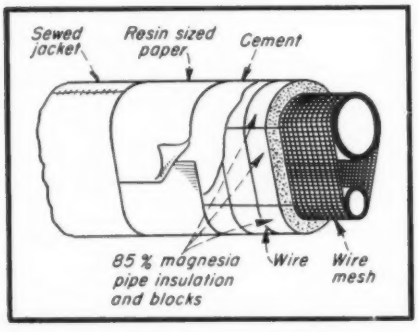
Since the water level had risen considerably the accumulator was then blown down. In later, normal operation the excess water was used for boiler feed and the accumulator blown down only once a week.

It is important to keep the check valves in perfect working order. When boiler pressure drops below accumulator pressure the outlet-line check valve opens and the hot water flashes into steam with the falling pressure. With boiler pressure rising above accumulator pressure the outlet check valve closes and the inlet check valve opens, letting steam enter through the injection nozzle. Incoming steam condenses and gives up its heat to the stored water.

Without the accumulator, boiler pressure would drop to 55 psig when starting a curing cycle. When the accumulator operates, boiler pressure drops to only 75 psig. Another advantage of the accumulator was discovered accidentally. While the vulcanizers were loaded and curing, one of the electrical controls on the boilers burned out, shutting them down for 20 min until a repair could be made. The curing cycle was carried on by the accumulator without interruption, until the boilers came back into service.

Shell of the accumulator was lagged with two inches of insulation, one inch of magnesia block and one inch of asbestos cement. All steam lines were also well lagged.

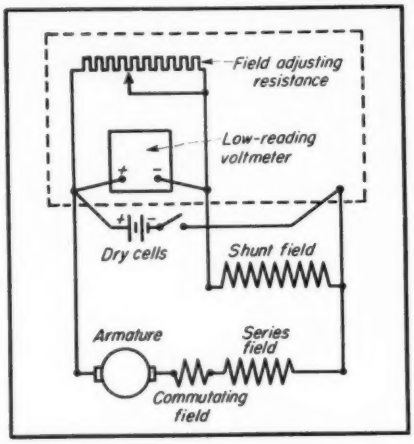
JOHN B THUMAN *Buffalo, N. Y.*



How to Insulate Steam-Traced Piping Effectively

HALF SECTIONS of semicylindrical molded pipe insulation, each half sized for its respective line, should be fitted around the process line and the steam pipe. At the two sides, blocks of the same thickness as the pipe insulation and cut to fit, should be carefully inserted between the semicylindrical sections, as in sketch. Half sections and side blocks should be tightly butted together and firmly fastened in place with iron wire. All joints should be pointed up with asbestos cement, and the entire outer surface covered with a layer of the cement reinforced with hexagonal wire mesh and troweled to a smooth, hard finish. The two lines may be first wrapped with wire mesh before applying the insulation.

Steam-wrapped piping should first be covered with galvanized expanded metal lath, laced in place with iron wire before applying insulation.



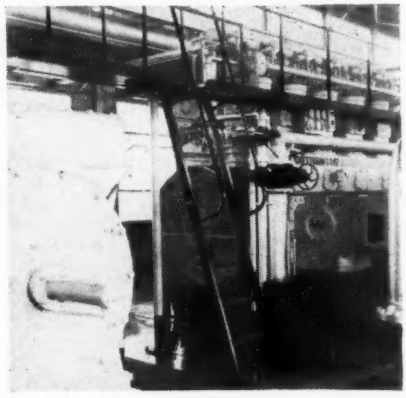
Inductive Kick Checks Motor Compounding

DC MOTOR DRIVE is coming back because of flexibility and accuracy of electronic control. Since these motors usually have series fields the old question comes up of how to check the field connections to be sure they are cumulative. The old method of starting with the shunt field open and getting the same rotation proves too dangerous.

The sketch shows a method I developed during the war to use when the controller is several decks below the motor. All that is needed is a low-reading voltmeter of the analyzer type and two dry cells. Connect the voltmeter across the shunt-field rheostat and the batteries across the armature and series field. The following action depends on the inductive coupling between the field windings.

With meter and battery polarities connected to give up-scale readings, make and break the battery circuit. If the fields have the right polarities the voltmeter will kick down below zero when the circuit is made and then show a steady up-scale reading, which should be in the same proportion to battery voltage as the resistance across which it is connected is to the total shunt-field circuit resistance.

MAX PAFENBACH *Dalton, Mass.*



Continuous Walkway Saves Climbing

BY JOINING ADJACENT ends of walkways provided with a battery of gas engines in a power plant, a continuous walkway was developed that reduced the amount of climbing by the oilers.

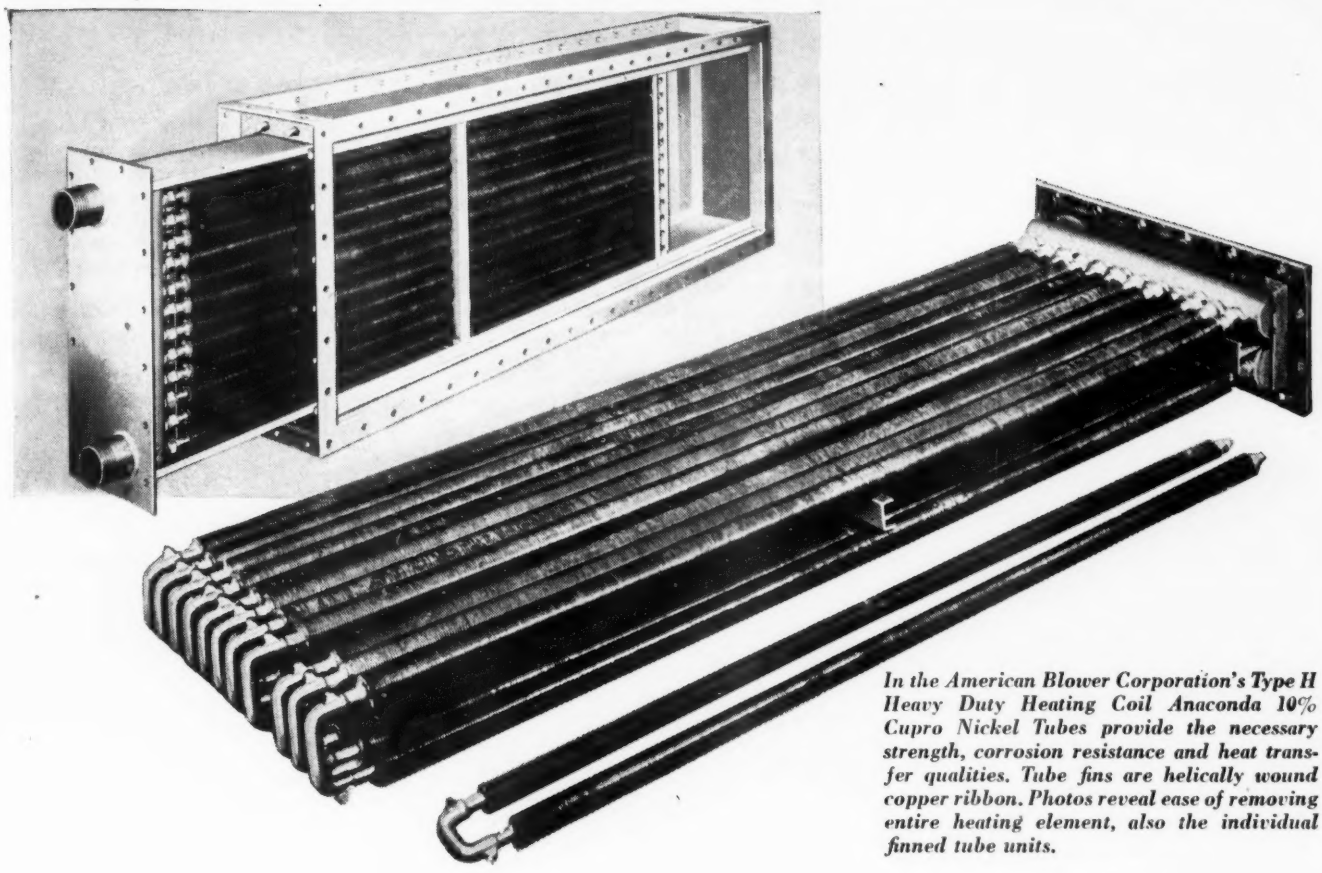
The short connection units, carried on the ends of the usual walks. also served as points for installation of the ladders or stairs giving access to the walk. This plan's saving in the number of ladders was realized without decreasing accessibility to any unit while always having ready avenues of escape in case of plant disaster.

The ladder sections, together with the short connecting bridge, are removed easily if the overhead crane must be used in an area normally occupied by a unit. In such cases the walks are blocked off and the remaining ladders continue to give access to the platform.

ELTON STERRETT *Houston, Texas*

CONTRIBUTIONS INVITED

POWER pays $20 for each item published in "Power Engineers' Notebook." Here's your opportunity to cash in on those professional tricks you have successfully used in the past, and help your fellow power engineers at the same time. Your manuscript need only be in rough form, giving all facts, with sketches in pencil. We will edit them for publication. This department covers power problems in design, operation and maintenance.



In the American Blower Corporation's Type H Heavy Duty Heating Coil Anaconda 10% Cupro Nickel Tubes provide the necessary strength, corrosion resistance and heat transfer qualities. Tube fins are helically wound copper ribbon. Photos reveal ease of removing entire heating element, also the individual finned tube units.

ANACONDA 10% CUPRO NICKEL TUBES

for heavy duty industrial service

THE AMERICAN BLOWER CORPORATION'S Type H Heating Coil, designed for heavy duty industrial work in which steam pressures up to 350 pounds and temperatures as high as 600° F. are used, is equipped with Anaconda 10% Cupro Nickel Alloy 754 Condenser Tubes.

This moderately-priced copper-nickel alloy, containing 10% nickel and 0.75% iron provides good corrosion resistance and heat transfer qualities. Tubes of this composition are in service in large power stations where operating conditions are particularly severe. It is one of four standard Anaconda Copper-Nickel Alloys furnished for heat exchange applications.

★ ★ ★

All told, there are eleven standard and several special Anaconda Condenser Tube Alloys—ranging from Deoxidized Copper and Arsenical Admiralty to Super Nickel 702 (30% nickel). The services of our Technical Department are available at all times to assist engineers and fabricators in the selection of alloys for heat exchange use. Please feel free to consult us, and write for a complimentary copy of Anaconda Publication B-2. 4570

ANACONDA
from mine to consumer

Anaconda

CONDENSER TUBES & SHEETS

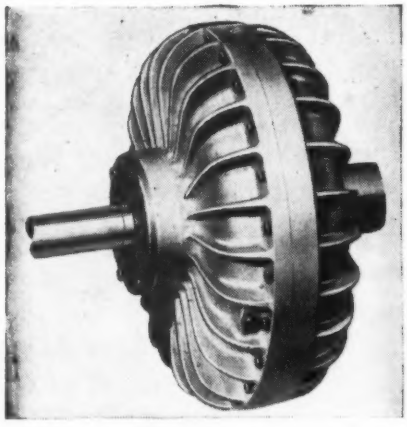
THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada: ANACONDA AMERICAN BRASS LTD.,
New Toronto, Ont.

NEW PLANT EQUIPMENT

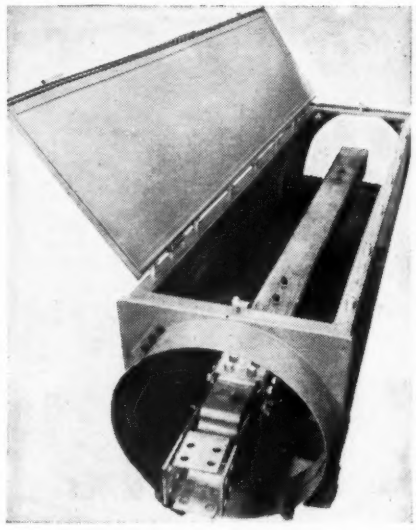
High-Pressure Valve

SHUTOFF VALVE has induction brazed joints that are capable of withstanding pressures up to 20,000 psi. Valve is for systems operating up to 5000 psi. Device features a poppet valve threaded to match the valve stem whose movement is rotary. Turning the valve stem moves poppet toward its seat and makes a perfect seal upon contact. Both seat and poppet are readily replaceable. Working parts can be disassembled without removing valve from panel or manifold. Finger-tip control turns the handle. All parts are of corrosion-resistant materials, properly treated for long life. **Greer Hydraulics, Inc, 454 18th St, Brooklyn 15, N. Y.**



Hydraulic Coupling

CARTRIDGE-MOUNTED SHAFT BEARINGS are designed as an integral part of a hydraulic coupling. Shaft-end bearings in the coupling assure permanent shaft alignment, prevent shaft play, possible damage to neoprene bellows seals and subsequent oil leakage. Extra large bearings easily carry combined radial and thrust loads as well as positively align runner and impeller elements. Straight radial vanes of the coupling make possible operation in either direction with equal efficiency. Low inertia of impeller and runner facilitates quick stops and reversing duty. The drive is available in 8.5 in. size up to 5 hp, and 9.5 in. up to 7½ hp. Drive makes it possible to use an electric motor of correct size to operate a given load at normal running speed; starts at virtually no-load and gradually accelerates the driven machine to speed. **CraneVeyor Corp, 1240 S Boyle Ave. Los Angeles, Calif.**



Enclosed Electrical Bus

AN ALUMINUM-ENCLOSED, isolated-phase bus is available for 15 kv application in current ratings of 1200, 2000, 3000, 4000, and 5000 amp. The housing is dust-tight and weather-tight, and may be used for indoor or outdoor installations.

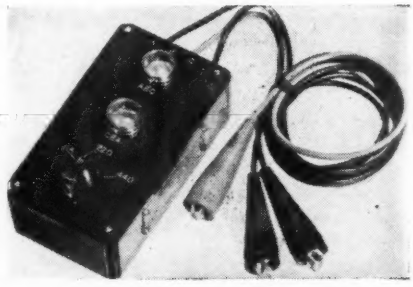
Each phase of the bus run has a single aluminum sheet shaped to form three sides of the housing. The fourth side consists of a gasketed, hinged, clamped cover. Installation expense is reduced since sections of the bus are shipped completely assembled. End bells of adjacent sections are connnected by split aluminum bands having gasketed mating flanges.

To form a length of three-phase bus run, three housings are bolted to cross members made from aluminum H-beams. Necessary structural steel members for attaching the H-beams to the building structure are supplied. **General Electric Co, Schenectady 5, N. Y.**

Automatic Oiler

A SMALL, COMPACT OILER that quickly attaches to electric motors, blowers, lineshafts and similar mechanisms, simplifies the problem of bearing lubrication. There are no floats, valves, or other moving parts in the lubricator. The exact oil level necessary for correct lubrication is always maintained.

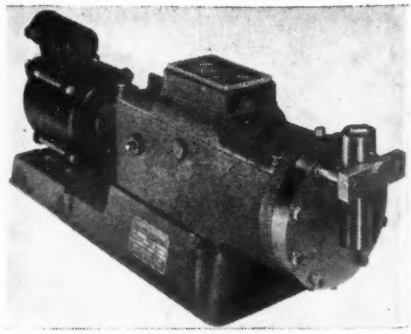
A sight glass on the side of lubricator bowl shows exact level of oil that is being fed to the bearing. In addition, total oil supply remaining in glass reservoir can be seen from a distance and checked regularly in a minimum of time. These oilers are suitable for lubrication of oil rings, capillaries, rollers, or ball bearings. **Acro Metal Stamping Co, 1913 N Buffum St, Milwaukee 12, Wis.**



Phase Sequence Indicator

THIS NEW PHASE SEQUENCE INDICATOR makes it simple to determine phase rotation. It is suitable for installing and servicing polyphase wattmeters, motors, watthour meters, power factor meters, alternators, transformer banks, and other electrical equipment.

To operate, the three leads are connected, one to each phase, and the switch turned to select proper voltage. If rotation is *C-B-A*, the lower lights will glow; if *A-B-C*, the top lamp lights. The Model 40 phase sequence indicator may be used on 115, 220 and 440-v circuits. The three leads, 3 ft long, with rubber insulated clips are designated *A*, *B*, and *C*. They are colored black and red for ease in connecting. The instrument weighs less than a pound and measures 2x3x5½ in. **Associated Research, Inc, 231 S Green St, Chicago 7, Ill.**



Proportioning Pumps

THESE PROPORTIONING PUMPS are for accurate feeding and are suited to a wide range of applications in laboratory, pilot plant, and industrial processing. The pump, a combination piston-diaphragm unit, has a piston that reciprocates over a measured stroke and displaces oil, which in turn pulsates a diaphragm. Hydraulically-measured pulsation of the diaphragm actuates flow of chemical being handled. Use of

No worry about "weak links" when all piping is Crane

The old saying "A chain is as strong as its weakest link" certainly applies to piping. But "weak links" needn't worry you when you standardize on Crane. For then you're assured the finest material for every part of the installation . . . valves, fittings, pipe and accessories.

And that goes whether you're installing an air compressor or boiler, a simple washdown line or complex processing system. Whatever your piping needs, Crane can fill the bill . . . in brass, iron, steel or alloys.

With this single source of supply you'll find piping procedures are simplified and speeded. From design to purchasing to erection to maintenance . . . work goes faster, smoother. And using Crane Quality in every part means uniform dependability in piping systems from end to end.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill. *Branches and Wholesalers Serving All Industrial Areas*

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SOURCE OF SUPPLY
RESPONSIBILITY
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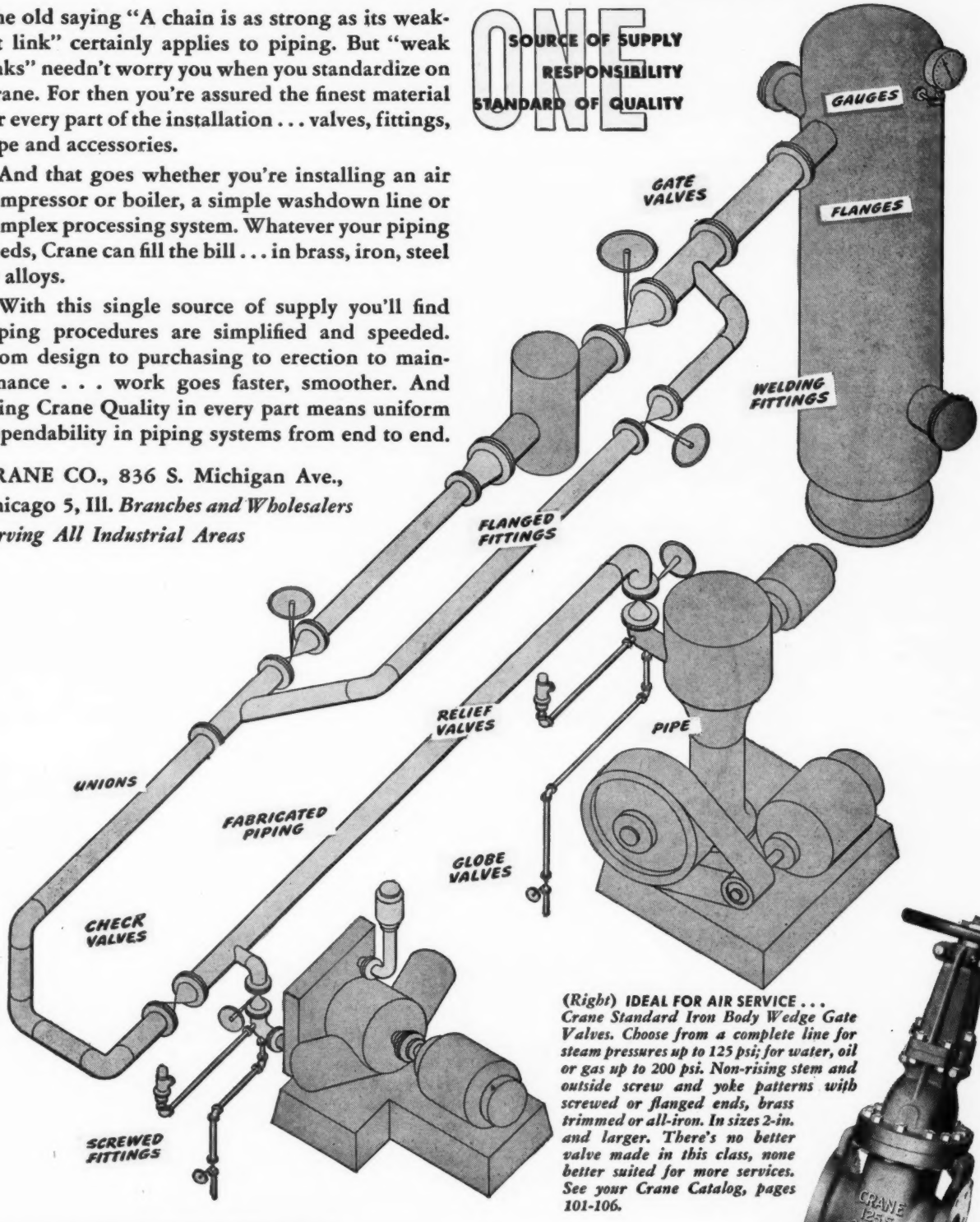
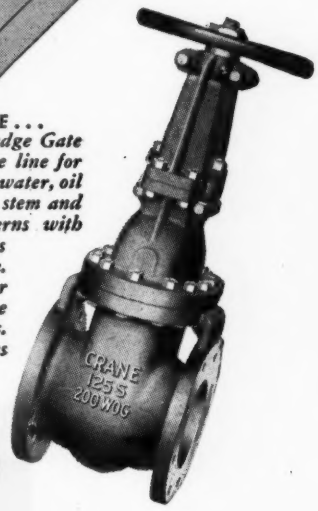




(*Right*) **IDEAL FOR AIR SERVICE . . .** *Crane Standard Iron Body Wedge Gate Valves. Choose from a complete line for steam pressures up to 125 psi; for water, oil or gas up to 200 psi. Non-rising stem and outside screw and yoke patterns with screwed or flanged ends, brass trimmed or all-iron. In sizes 2-in. and larger. There's no better valve made in this class, none better suited for more services. See your Crane Catalog, pages 101-106.*

EVERYTHING FROM . . .

VALVES . FITTINGS
PIPE . PLUMBING
AND HEATING

CRANE

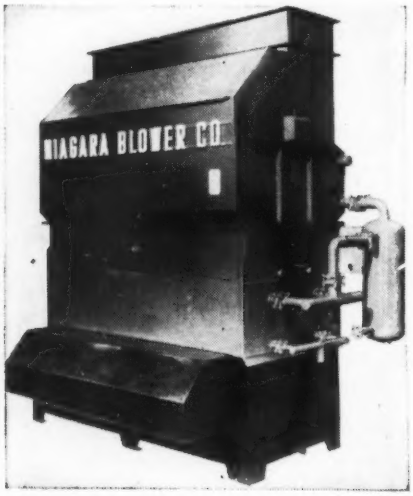
FOR EVERY PIPING SYSTEM

diaphragm eliminates stuffing box and isolates chemicals from pump parts. Pumps are micro-adjustable over the entire capacity range while in operation. Four sizes are available for flows from zero to 11, 40, 100, to 330 gph. Duplex, triplex, and other multiple-head arrangements are offered for continuous blending or feeding. Various valve designs, diaphragm materials and materials of construction are offered to meet the chemical requirements of specific applications. **Process Equipment Div, Lapp Insulator Co, 743 Maple Street, Le Roy, N. Y.**

Industrial Power Unit

KRW INDUSTRIAL POWER UNIT comprises Ford 100-hp engine, capable of operation on natural or bottled gas as well as gasoline, assembled with radiator, fan, governor, battery-starting system, and instrument panel. Built-in protective device breaks ignition circuit and stops engine if water temperature rises above 195 F or lube-oil pressure falls below 6 psi. Available in open and closed models, with or without clutch for direct drive, and with extension base for special mounting. Can also be furnished with 20-kw generator or centrifugal pump on same base.

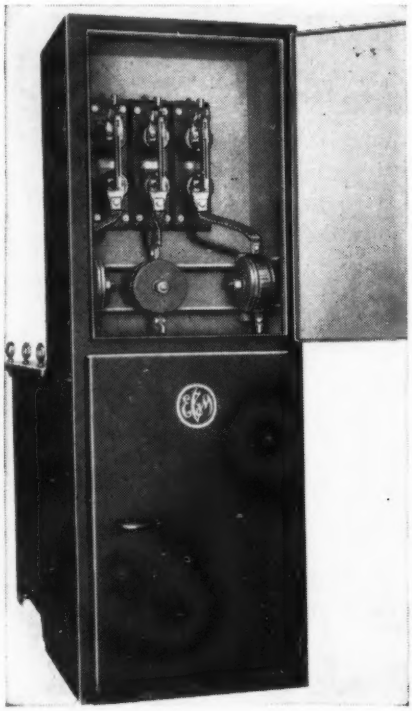
Suitable for direct drive of compressors, pumps, etc, and for generator drive (either regular or standby service), power unit may be rated at 2250 rpm, yielding 64 hp on gasoline and 55 hp on natural gas for short periods, 43 and 36 hp respectively, for constant-duty power. Speed of 1800 rpm is recommended as most economical for loads from 10 to 50 hp. **K R Wilson, 215 Main Street, Buffalo 3, N. Y.**



Gas Condenser

TWO COIL, refrigerant gas condenser passes gas over (1) a dry "Duo-Pass" coil, which, together with an "Oil-Out," removes superheat, condenses and separates oil vapor (2) a wet coil that condenses gas at a low temperature. This last coil is drenched by a water spray to remove 1000 Btu for each pound of water evaporated.

The casing is partitioned so that damper operation permits use of all fresh air or any degree of recirculated air. The proportions vary with condensing load and with changes in air temperature according to weather. All dampers are located internally. *Aeropass* condensers are manufactured in units ranging from 10 to 100 tons rated capacity. **Niagara Blower Co, 405 Lexington Ave, New York 17, N. Y.**



Motor Starter

RECENTLY DESIGNED *Valimitor* motor starters may be used at any point on any power system, regardless of the available kva. These new starters are for 2300-4600-v applications. Fault current is limited on any system to about 25,000 kva, which is easily interrupted by the magnetic contactor. As a result all apparatus on the system back to the power source is subject to reduced stresses should a short circuit occur in the motor or line protected by *Valimitor*.

The motor starter is built to provide across-the-line starting for squirrel-cage, synchronous or wound-rotor motors. A style is also available for reduced voltage starting. The 2300-v top rating is 600 hp for 60 cycle and 300 hp for 25 cycle systems. Similar ratings hold for 4150- and 4600-v systems. **Electric Controller & Mfg Co, 2700 E 79th St, Cleveland 4, Ohio.**

Temperature Instrument

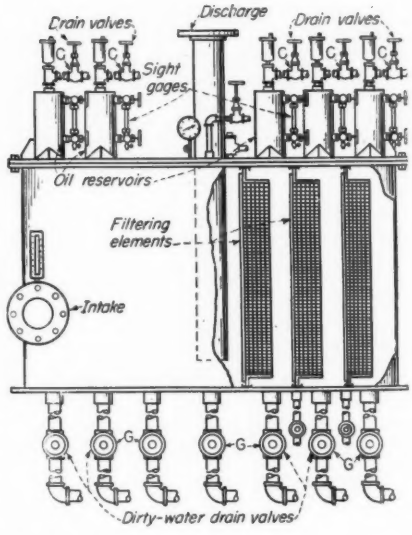
SINGLE CAPILLARY, organic-liquid actuated temperature system is particularly adaptable to applications where (1) a small bulb is required; (2) short range intervals are desirable; (3) manufacturing process is sensitive to mercury; (4) subzero temperatures are encountered. The system utilizes a single-bore capillary and a single bourdon spring with a U-shaped bimetallic compensator on the spring for case temperature changes. Uniform charts are used and the system is available with the usual fittings, armor, etc. **Taylor Instrument Cos, Rochester 1, N. Y.**

Air-Line Filter

MODEL 605 LUBRI-FILTER combines a lubricator and filter and is designed for compressed-air lines. It protects air-driven equipment against dry-running breakdowns and impurities in the air supply. Atomized oil is automatically injected into the air line in proper amounts and oil level may be seen from any angle. Filter is built of aluminum and brass. **Jarett Compressor & Equipment, Inc, 275 Central Ave, Newark 4, N. J.**

Regulator Diaphragm

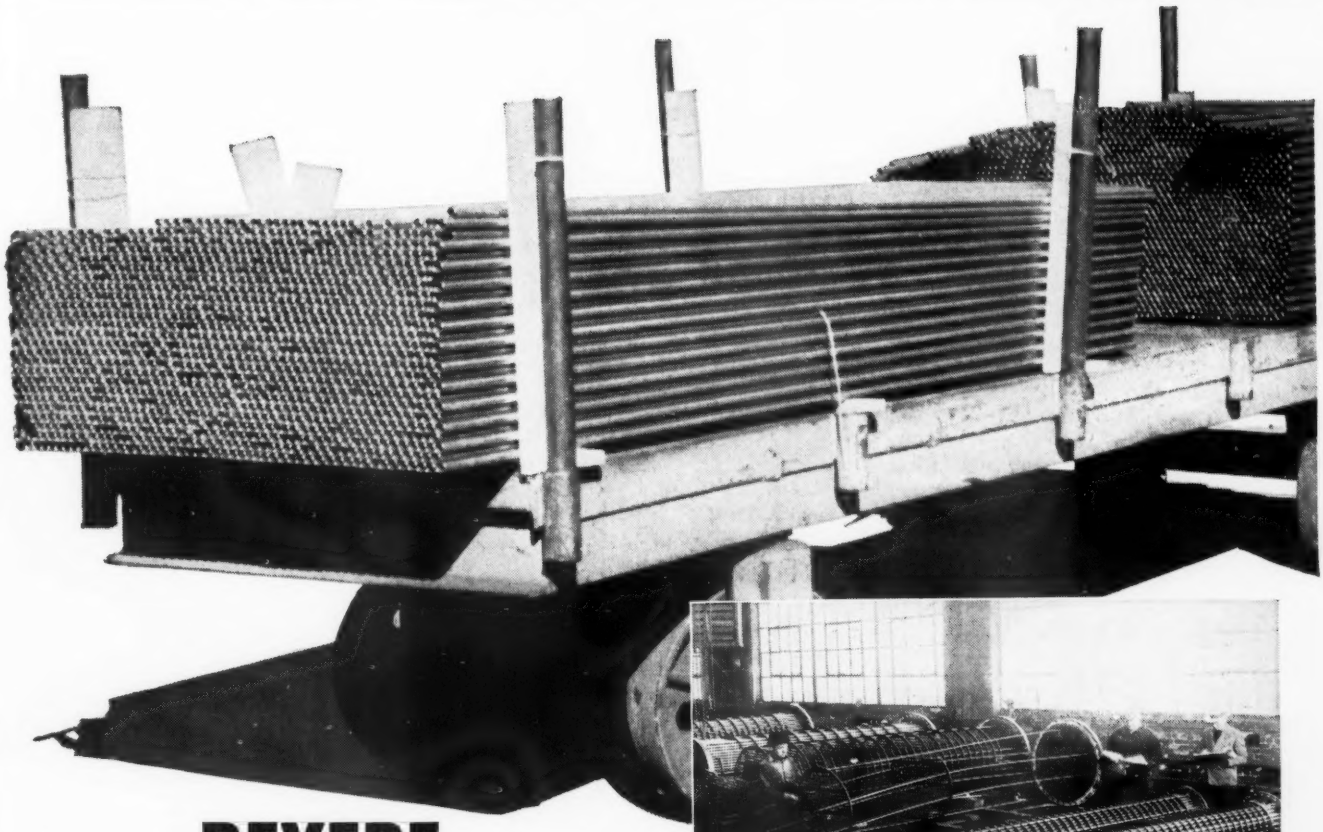
NYLON FABRIC is combined with rubber to make a new sheet material for pressure-regulator diaphragms. The new material has greater flexibility, is lighter in weight, and has higher bursting strength and improved sensitivity, says the manufacturer. It can be supplied in sheets 36 in. wide and 1/32, 1/16, $\frac{1}{8}$, 3/16 and $\frac{1}{4}$ in. thick. Sheets may be die cut to fit various pressure regulators used to control the flow of water, air, oil, steam, acetylene, illuminating gas, chemicals and other liquids and gases. **U. S. Rubber Co, Rockefeller Center, New York, N. Y.**

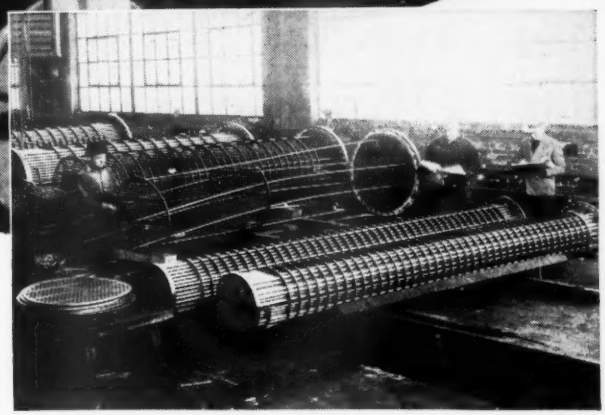


Deoiling Apparatus

DEOILER REMOVES OIL, oil emulsions, scale and decomposed oil from boiler feed water and from water for industrial processes. It consists of a closed vertical cylindrical shell that contains the separating and filtering elements. Knitted steel wire, the basic separating material, is placed on hollow cylinders with walls of appropriate thickness for the particular design. Usually each unit has three cylinders

MEETING SPECIAL CONDITIONS





REVERE

REVALON and CUPRO-NICKEL

Because each condenser and heat exchanger presents its own special combination of conditions, no blanket recommendations for condenser tube alloys are possible. However, this much can be stated authoritatively: there are three Revere Metals which deserve special consideration in cases of limited or unsatisfactory tube life. Here they are:

Cupro-Nickel, 30%. Withstands high operating temperatures. A tenacious surface film forms on this metal, which resists impingement attack and erosion, salt water, and waters containing organic material. Widely used in marine and seaboard installations, the tropics and subtropics.

Cupro-Nickel, 20%. Similar to Cupro-Nickel, 30%, but lower in price and somewhat less resistant to certain types of corrosion.

Revalon (Aluminum Brass). This Revere Metal contains a small proportion of aluminum, which gives it a long life in applications where water velocities are high or water is saline. The film formed on this tube is tenacious and self-healing, rendering it highly resistant to impingement attack.

Which of these types to select, or which of the five other types of Revere Condenser Tubes should be chosen, depends on individual conditions. The Revere Technical Advisory Service will gladly collaborate with you in arriving at a decision as to the most economical tubes for your plant.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N.Y.—Sales Offices in Principal Cities, Distributors Everywhere.

set concentrically within the shell. Water to be purified passes radially from outer shell through filtering elements to the center. Oil particles in the fluid lodge on the elements and gradually form globules, which work upward and collect in chambers on top cover. Sight gages show amount of oil collected in these chambers from where it is drained off through valves *C*. Finely divided solids fall to the bottom and are flushed out through valves *G*. Equipment available in five sizes, 20, 50, 60, 80 and 125 gpm. **Lawson Products Corp, 39 Broadway, New York 6, N. Y.**

Fuel Additive

NON-TOXIC, non-corrosive mixture, known as *Houghto-Solv*, mixes with sludge in oil-storage solution and makes a burnable mixture. It is added directly to the fuel tank in the ratio of one quart to 1000 gal. **E F Houghton & Co, 303 W Lehigh Ave, Philadelphia, Pa.**

Flexible Tubing

RONAFLEX FLEXIBLE TUBING uses *Buna* and *Neoprene* base synthetics that stand up under high temperature, pressure, vibration, corrosive solvents and fumes. One-quarter inch tubing will stand bursting pressures up to 1000 psi; larger sizes proportionately less. Installations for temperatures up to 300 F are not uncommon.

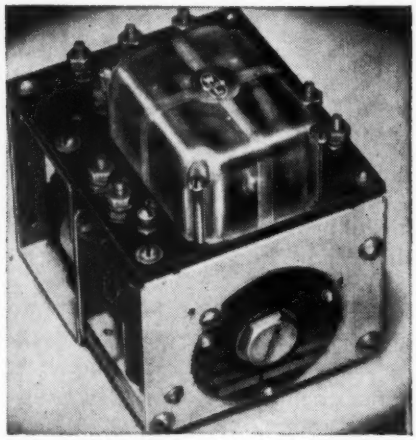
Standard sizes run from ¼ to 2 in. ID, and in a complete range of lengths up to 200 ft in the small diameter, and 50 ft in larger diameters. **Ronaflex Tubing Co, Packard Bldg, Philadelphia 2, Pa.**

Pipe Cleaner

MILLER ROD HOUSE pipe cleaner is made from high grade music wire. By turning the speed handle, rod is forced down the pipe, cleaning out obstructions. When not in use, flexible rod is coiled inside a case, making the tool a self-contained unit. Device is available with rod from ¼ to ½ in. in dia and from 50 to 75 ft long. **Miller Sewer Rod Co, 4642 N Central Ave, Chicago 30, Ill.**

Diaphragm Head

REVERSING SUPERSTRUCTURE for diaphragm regulating valve permits reversing valve action by simply substituting a new head for the standard superstructure. Valve need not be removed from pipeline. Reversing superstructure duplicates performance of standard superstructure in every way. Therefore same valve characteristics are maintained when changing from one to another. Base is 12 in. in dia, rust-proof underneath, and enameled a bright red on top for better visibility. **Leslie Co, 50 Delafield Ave, Lyndhurst, N. J.**

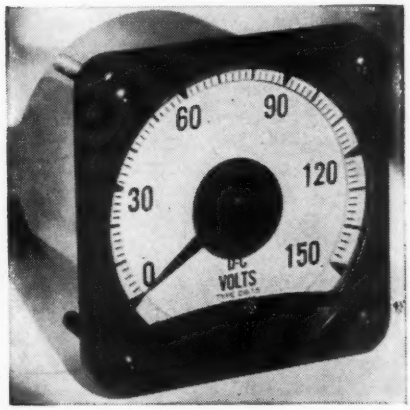


Time Delay Relay

THIS TIMING RELAY is designed especially for machine tool, signal, sound and other control systems. Essentially, the relay consists of a small synchronous motor, a differential gear system, a built-in break assembly and an auxiliary relay. By connecting external connection jumpers to the relay terminal board, two different timing sequences can be obtained. With one set of connections "delayed make" with a maintained pilot circuit is provided. The other set of connections permits "instantaneous make" and "delayed break" with a momentary contact pilot circuit. The timing of this relay is easily adjusted over a wide timing range, the maximum being 63 min. **Ward Leonard Electric Co, Mt. Vernon, New York.**

Refractory

HIGH-STRENGTH, chrome-base refractory concrete withstands temperatures as high as 3100 F. *Kromecast* can be poured like ordinary concrete or plastered with a cement gun. This means the refractory can be installed in a fraction of the time required for plastics and, states the manufacturer, serves as vertical wall and roof arch in many types of furnace. **Babcock & Wilcox Co, 85 Liberty St, New York 6, N. Y.**



Switchboard Instruments

THESE NEW INSTRUMENTS have scales 7.1 in. long spanning 250 deg about the center. Major numbered divisions are accentuated. All legends such as "a-c amperes", etc, are located below center of scale, hence are never partially covered by pointer. All scale numerals are horizontally placed to facilitate reading.

The new Type *AB*-15 (ac) and *DB* 15 (dc) instruments are for general switchboard use by electric utilities and large industries. Using bearings with spring-mounted jewels designed to protect the pivot under abnormal shock, new bearing construction permits hard use without harm to pivot. The instrument can be easily disassembled for inspection or repair. Moving elements may be withdrawn from the mechanism without disturbing control springs or jeweling. New long-scale line retains many features found in present switchboard instruments put out by this manufacturer. **General Electric Co, Schenectady 5, N. Y.**

Brake Shoe Lining

A BRAKE SHOE has clamp-on lining for use with magnetic brakes for mill and heavy-duty service. A vise-type clamp on brake shoe holds brake lining securely in place.

(*Continued on page* 160)

NEW

Nalcometer

New Features . . .

- *4 wide ranges,* for accurate measurement of dissolved solids from 0.4 parts per million to 1,000 grains per gallon.
- *Direct-reading*—no charts, scales or calculations.
- *Exclusive patented electrodes* do not require re-platinumizing.
- *Compact* . . . measures only 3¾" x 8" x 8" overall.
- *Rugged* . . . Stainless steel case houses shock-mounted internal mechanism.
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How to plan
HIGH PRESSURE CONDENSATE
FLASH TANK CONNECTIONS
Another in the series of basic Piping Layouts
prepared by Jenkins Bros.

A central boiler provides steam, in many installations, for a number of buildings spread over a wide area. Often, in such cases, it is too expensive to install more than one return main from each building back to the boiler. To prevent disturbances caused by the flashing of the high pressure condensate discharge directly into the low pressure main, a condensate flash tank is usually installed. This is a practical and efficient method of handling high pressure condensate and returning it to the boiler.

Typical use of high pressure steam, in a dryer where it may be required at pressures up to 150 lbs. p.s.i., is shown in this layout. The high pressure condensate is trapped and discharged to a flash tank in which a liquid level is maintained to provide water at all times. This protects the low pressure equipment from destructive effects of "blow through" of the high pressure condensate flashing. The flash tank is provided with a safety valve that operates if the low pressure trap should be out of service. This also makes possible the use of low pressure equipment beyond the tank. After conversion to low pressure in the flash tank, the condensate is discharged into the regular low pressure return main.

A pressure reducing valve system, complete with a three valve by-pass and safety valve, is shown for supplying the low pressure main directly from the high pressure main. The unit heater, using low pressure steam is equipped with a thermostatic valve instead of the conventional motor control for the fan. This type of control is used in drying rooms because the unit heaters are used to draw fresh air through ventilators when dryers are in operation.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation. Copies of Layout No. 36 will be sent on request. Just mail coupon.

Fig. 956, a Bronze Globe Valve used in this layout, is especially suitable for severe service where tightness is essential. Stainless steel plug and seat can be reground without removing valve from the line—can be reground repeatedly before renewal is necessary.

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Fig. 956
Regrind-Renew
BRONZE GLOBE VALVE
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400 Pounds O.W.G.

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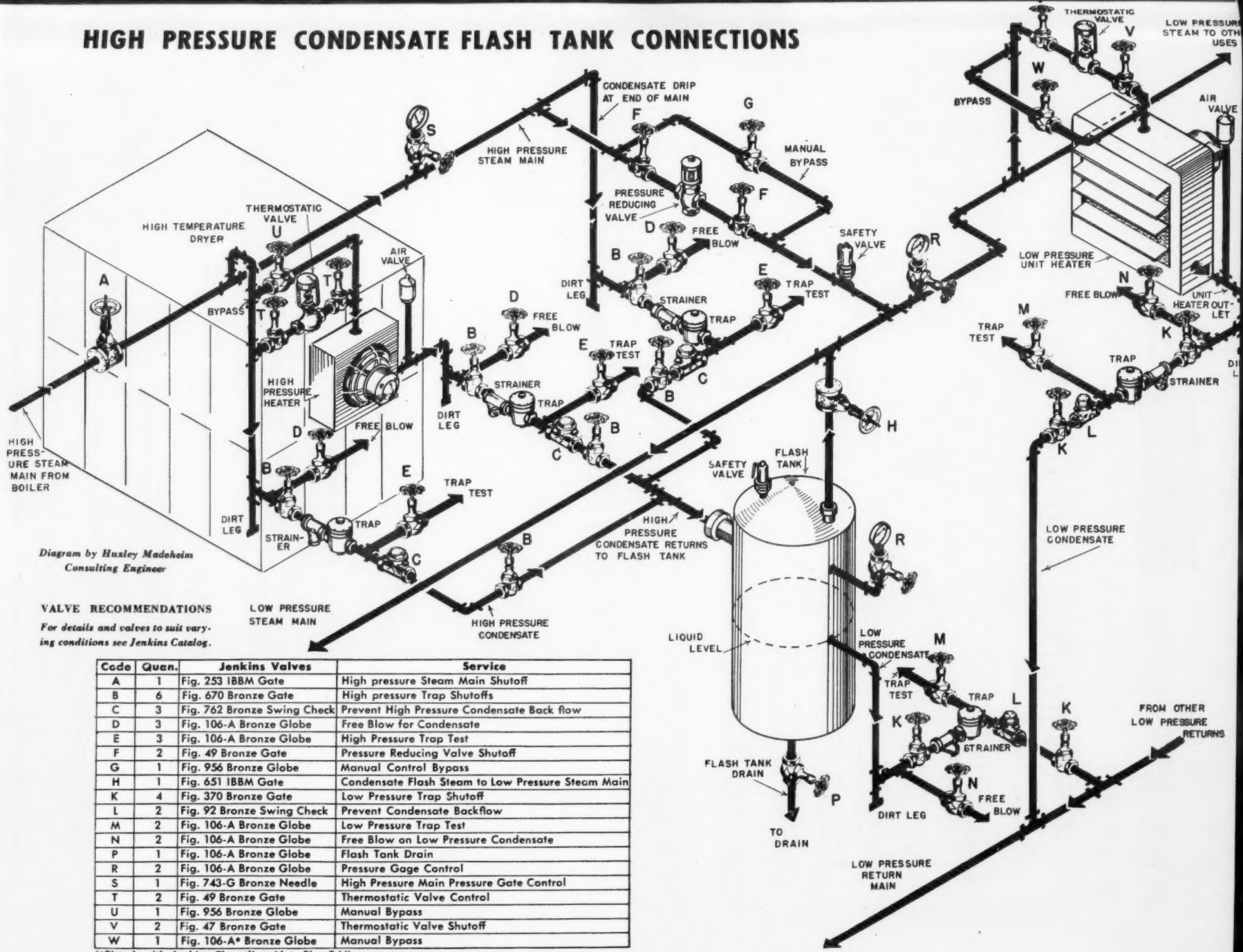


Diagram by Huxley Madeheim Consulting Engineer

VALVE RECOMMENDATIONS

For details and valves to suit varying conditions see Jenkins Catalog.

Code	Quan.	Jenkins Valves	Service
A	1	Fig. 253 IBBM Gate	High pressure Steam Main Shutoff
B	6	Fig. 670 Bronze Gate	High pressure Trap Shutoffs
C	3	Fig. 762 Bronze Swing Check	Prevent High Pressure Condensate Back flow
D	3	Fig. 106-A Bronze Globe	Free Blow for Condensate
E	3	Fig. 106-A Bronze Globe	High Pressure Trap Test
F	2	Fig. 49 Bronze Gate	Pressure Reducing Valve Shutoff
G	1	Fig. 956 Bronze Globe	Manual Control Bypass
H	1	Fig. 651 IBBM Gate	Condensate Flash Steam to Low Pressure Steam Main
K	4	Fig. 370 Bronze Gate	Low Pressure Trap Shutoff
L	2	Fig. 92 Bronze Swing Check	Prevent Condensate Backflow
M	2	Fig. 106-A Bronze Globe	Low Pressure Trap Test
N	2	Fig. 106-A Bronze Globe	Free Blow on Low Pressure Condensate
P	1	Fig. 106-A Bronze Globe	Flash Tank Drain
R	2	Fig. 106-A Bronze Globe	Pressure Gage Control
S	1	Fig. 743-G Bronze Needle	High Pressure Main Pressure Gate Control
T	2	Fig. 49 Bronze Gate	Thermostatic Valve Control
U	1	Fig. 956 Bronze Globe	Manual Bypass
V	2	Fig. 47 Bronze Gate	Thermostatic Valve Shutoff
W	1	Fig. 106-A* Bronze Globe	Manual Bypass

(*Fitted with Jenkins Throttling Nut, Fig. 344)

Universal Tank-Capacity Scales

► THESE SCALES can be used to measure the volume of liquid contained in a horizontal cylindrical tank with flat vertical ends. Total volumetric capacity of a tank can be calculated easily by the usual formulas. Difficulty arises, however, when we wish to measure the contents of a partly filled tank. Soundings of a partly filled tank can be readily made in the usual case and the depth of liquid determined. This depth can then be expressed as a percent of tank diameter, which equals (depth/dia)x100. Referring to the scales, this percentage will be found to equal a volume expressed as a percentage of the total tank internal volume.

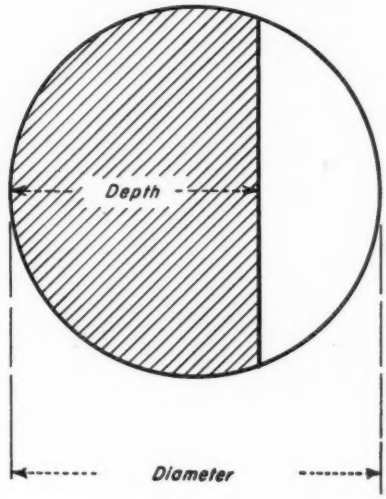
Example: An 84-in. internal-diameter tank has a total capacity of 3000 gal and contains a liquid with a depth of 50 in. How many gallons are in the tank?

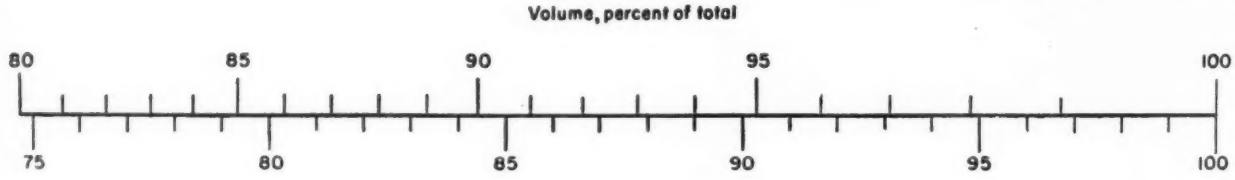
$$\text{Depth} = \frac{50}{84} \times 100 = 59.5\% \text{ of tank diameter}$$

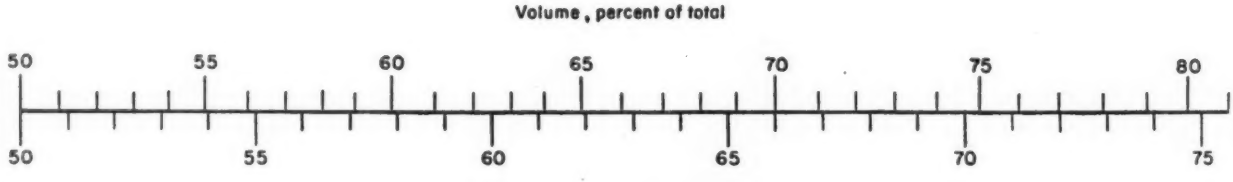
From the scales the corresponding volume = 61.9% of tank capacity

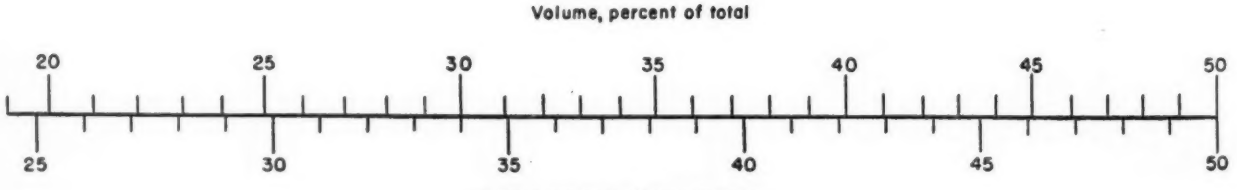
$$\text{Liquid in tank} = 3000 \times \frac{61.9}{100} = 1857 \text{ gal}$$

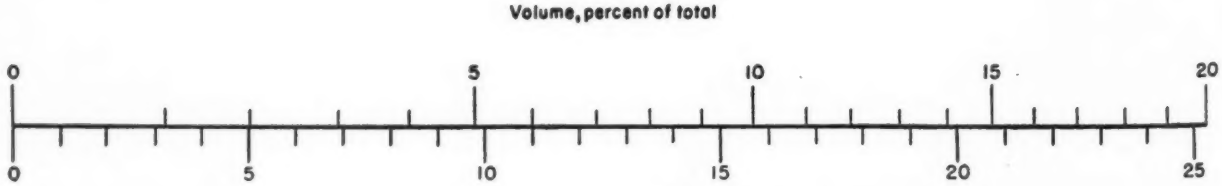
By W H Wieboldt, Enterprise, Fla.











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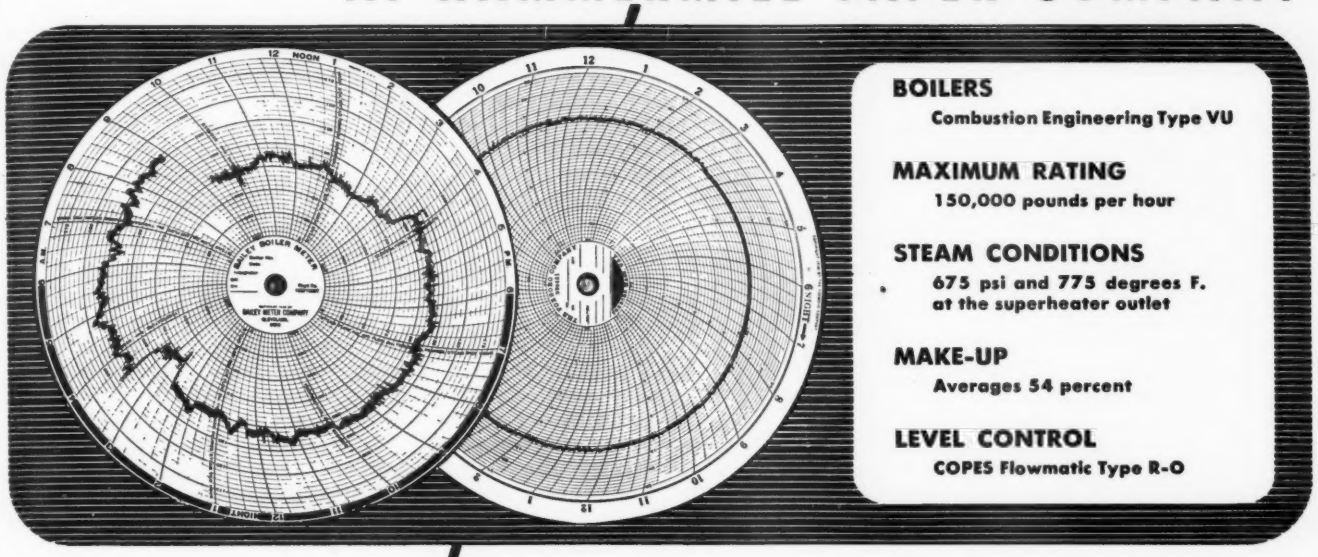
AT HAMMERMILL PAPER COMPANY



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PROBLEMS FROM THE PLANT

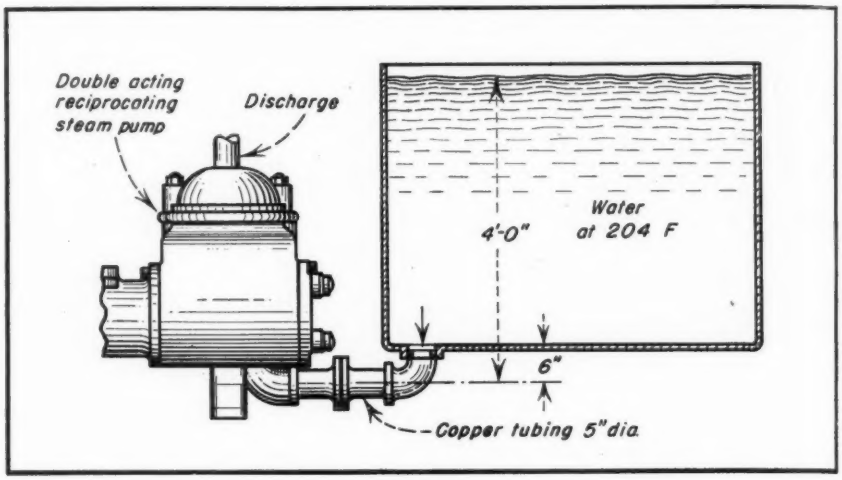
Exercise your engineering wits by submitting answers to this question, fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

What Can We Do to End Steam-Pump Slam?

WE ARE HAVING TROUBLE with a reciprocating steam pump in our plant. As shown in accompanying sketch, the pump handles hot water at a temperature of 204 F.

When the tank is full, pump suction is about 4 ft below surface of liquid When tank is empty this distance reduces to 6 inches. Suction line to the pump is 5 in. dia, copper tubing about 6 ft long; the discharge dia. is 4 in. Pump is double-acting reciprocating steam type, 12x10½x14, operating at 70 strokes per minute. Pump head is 35 lb.

The pump slams and we have geat difficulty keeping the valves tight. There is no way of increasing the suction head. Will POWER readers tell us how to make this pump operate quietly?—**GR**



Readers' Answers

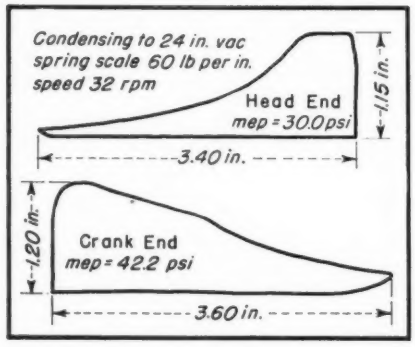
How Can We Stop Pound In a Corliss Engine?

(This question is from April issue with best answers from readers.)

Our plant has four vertical single-eccentric 42x60x74 corliss engines, which are used to blow air into blast furnaces. The normal speed is 45 rpm with a capacity of 11,700 cfm.

Recently one of the engines developed a pound on the bottom center. When running full speed, the pound is very heavy. It is considerably reduced when we run the engine at 35 rpm. We have changed crank and crosshead brasses, checked for loose pistons, as well as tightening up all around. Since no improvement was noted we repaired the flyball governor but to no avail.

We have taken the indicator cards, shown in the diagram, to help solve our problem. It is our belief, after studying the cards, that the pound is caused by the absence of cushion steam at the end of the exhaust stroke. This lack is due to the exhaust valves closing too late. We also believe the steam valves open too late on both ends. On the crank end, the exhaust valve is apparently opening late and the steam valve is leaking after the point of cut-off.



Do POWER *readers agree that these valves are in need of adjustment, both to eliminate the pound and to increase engine efficiency?—AJS*

Check Eccentric Setting And Then Reset Valves

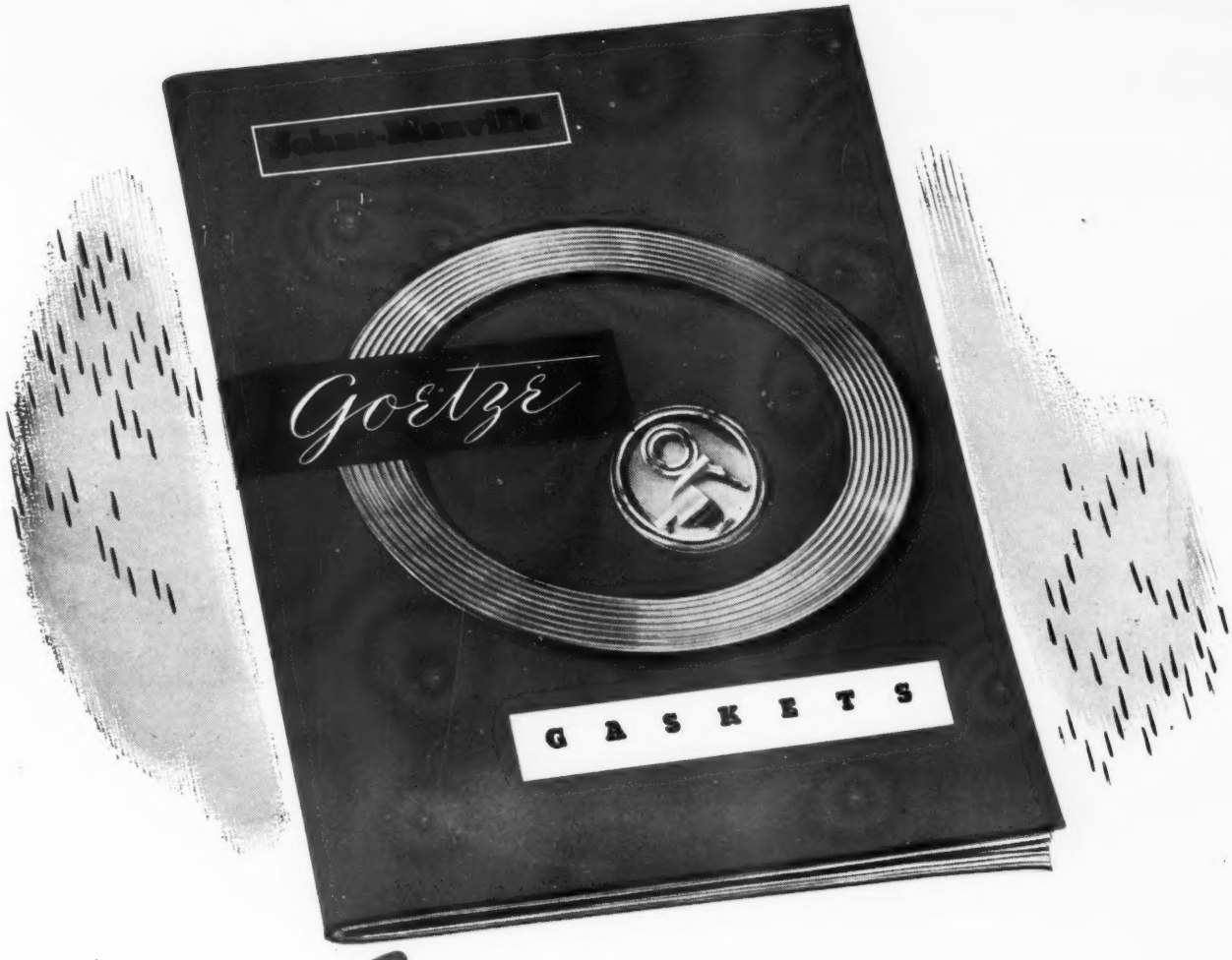
A STUDY OF *AJS's* indicator cards shows that late release is taking place on both crank and head ends. This causes the sharp point on end of diagram. Release at the correct moment would produce a rounded tip with a greater slope at end of release line. To rectify this condition both exhaust valves have to be set to open earlier.

Compression appears faulty because the compression line is nearly perpendicular to the exhaust line for both ends of cylinder. In general, compression curve should be the converse of expansion curve. Late closure of exhaust valves causes compression curve to appear as a straight line about perpendicular to the exhaust line. Resetting exhaust valves to close earlier will remedy this condition.

Knock on the engine's crank end when operating at 45 rpm results from late closure of exhaust valves, and hence insufficient compression. A similar knock does not occur at the head end because weight of reciprocating parts is acting downward. By resetting exhaust valves, *AJS* can readily eliminate the engine knock.

The steam valves appear to be set better than the exhaust valves. The slight forward slope of inlet lines indicates that admission is late by a small amount. Resetting steam valves will improve work area of the diagram by giving vertical admission lines. To do this lap of admission valves must be reduced.

Before resetting the valves, *AJS* should check to see if the eccentric has slipped on engine shaft. A change in



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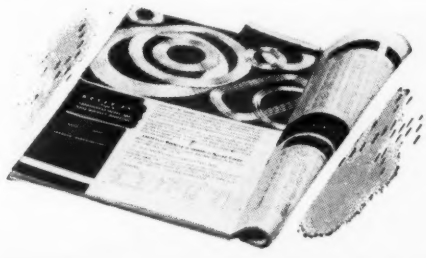
If you buy or use metallic gaskets, you'll find the new Goetze Catalog a valuable reference guide. Write, on your company letterhead, for your free copy. Address Johns-Manville, Box 290, New York 16, N. Y.



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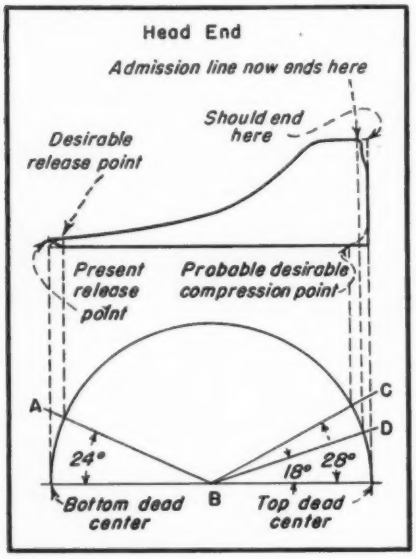
the eccentric's position would cause valve action shown by indicator diagrams. Slippage of the eccentric is not uncommon. Thus to eliminate knock and increase engine efficiency, he should check the engine eccentric, then reset valves.—**Tyler G Hicks, New York City**

How to Set Eccentric

ANALYSIS OF indicator cards is correct but not complete. *AJS* should check the piston end clearance. A small lead slug



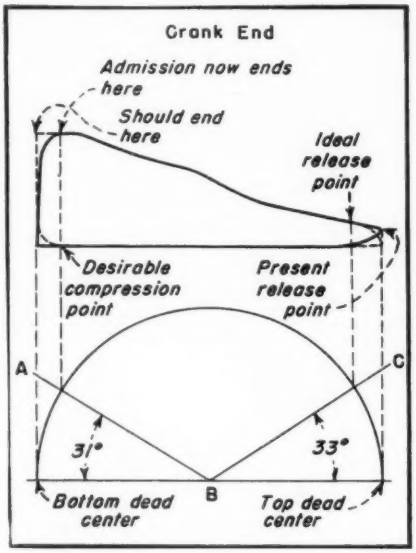
on a wire can be inserted through an indicator-card connection, or through a valve pan and into the clearance space. Engine should be off dead center. When jacked over dead center the lead will be crushed. It can then be "miked" to obtain the clearance measurement.

Sketches illustrate a simple, accurate method of arriving at proper eccentric settings. Parallel vertical lines are drawn, just touching extreme ends of indicator diagrams. These extreme ends represent the opposite dead centers of the revolution. A horizontal line is drawn through the circle intersecting at the tangent points. This gives us a circular diagram of engine revolution in scale with the indicator diagram.

As *AJS* points out, steam admission is late, release point (exhaust opens) late, and compression point (exhaust closes) late. As a trial setting, I have assumed a compression point and a probable compression line (dotted). If clearance is small, compression line is steeper and of necessity occurs later or closer to end of stroke to avoid excessive compression.

Radii through the points where vertical parallel lines intersect the circle give a means of determining number of degrees the present points vary from the desired ones. It so happens here that the desired point on admission line coincides with the dead-center line. On the other end the present release point coincides with the dead-center line. Accordingly, angles are measured in this case from that line.

Averaging readings from both cards, admission is approximately 25 deg late, exhaust opens about 28 deg late. Exhaust closes about 30 deg late. Since admission lines are the most accurately determined, the others being based in part on assumptions and since all points are late by a similar amount, the eccentric should be advanced from its present position 25 deg. New cards should be taken. Differences between opposite ends are equalized with the individual link-rod adjustments. Another set of cards should then be taken and if still in error the same method of



marking off will give a final accurate eccentric position. Two adjustments should be enough for satisfactory results.—**J B Murphy, New York City.**

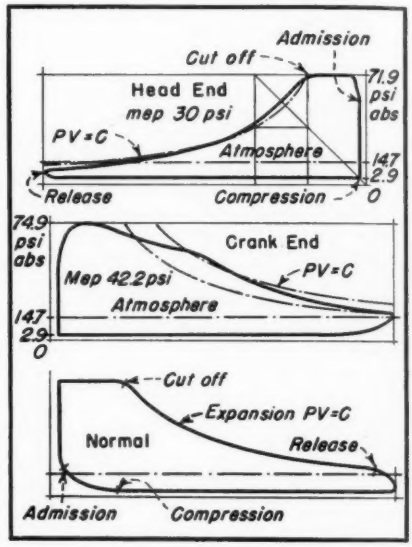
Engine Valves Need Repair

TO ANSWER the last part of *AJS's* question first, valves need repair and adjustment to eliminate pound. The increased efficiency will probably pay for the work. All settings are late on both cards, which means the eccentric has slipped back. Crank-end card looks as if valve knock-off cam failed to release the latch since there is no characteristic cutoff point. In addition, it shows a leaky exhaust valve.

First step is to get the valves in good repair after that, valves, rods and eccentric must be adjusted. *AJS* will find details for proper adjustment in Croft's *Steam Engine Principles and Practice*. **N A Helmer Jr, Plainfield, N. J.**

Indicator Cards Analyzed

ENGINE POUND is probably at the crankpin since noise increases with speed. Knock occurs when connecting rod stops pushing on one side of crankpin, slams through bearing clearance space and starts pulling on other side of pin.



Knock can be reduced by cutting down clearances and having reversal of force take place at a slow rate.

Release and compression on both ends as well as admission on head end are retarded by the same amount. Admission on crank end is even later. *AJS* can correct this by advancing the eccentric until he obtains the desired compression. This will also take care of late release and advance admission. If crank-end admission is still late, adjust length of steam valve rod to reduce the lap. Head end may also require adjustment. At dead center, steam valve should be 1/32 to 1/16 in. open for lead.

By drawing the head end $PV = C$ curve, as in sketch, actual expansion line is seen to be high at start, and low at end of stroke. Former is a sign of slight steam-valve leakage. Latter indicates leaky exhaust valve, leaky piston rings, or condensation. The last is unlikely, unless the card was taken at start of run.

Sketch also shows similar rectangular hyperbolas or $PV = C$ curves for the crank end—one drawn through bottom

(*Continued on page* 148)

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REVIEWED IN THIS ISSUE

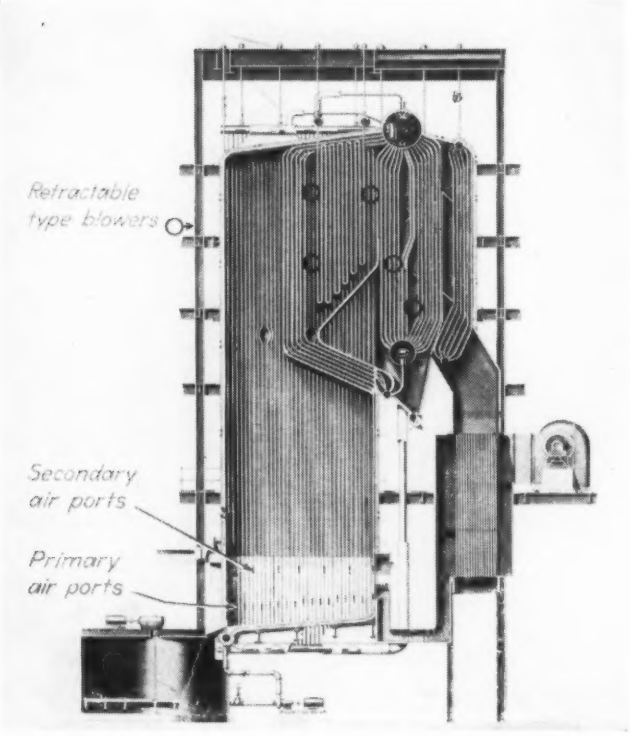
FUELS AND FIRING

Utilizing Bagasse as Fuel
Developments in Kraft-Process Recovery-Unit Design and Performance
Mechanisms of Combustion and Their Relation to Oil-Burner Design
Synthetic Liquid Fuels in the United States Today

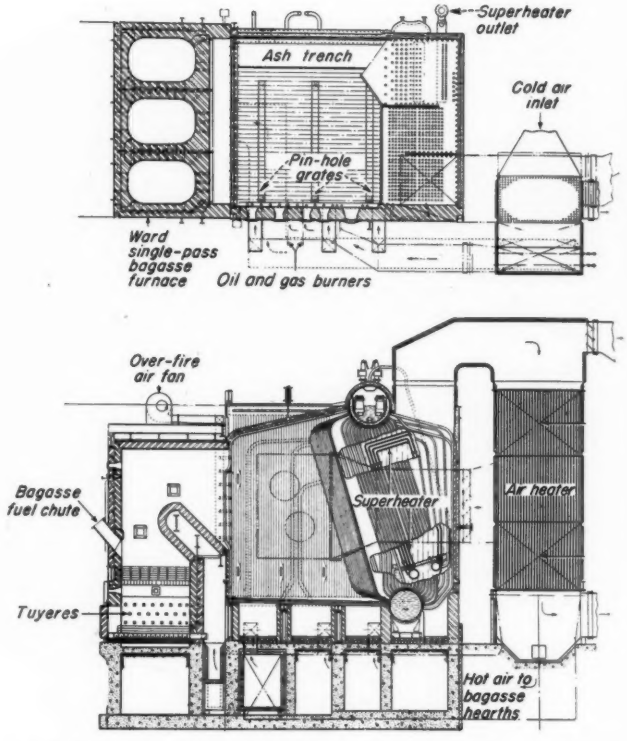
GAS TURBINES

Performance of Commercial Gas Turbines
The Gas Turbine Considered for Stationary Prime Mover Operation

Directions for ordering papers are given on page 134



1 Design improvements in paper-making recovery units led to higher unit capacity and reduced cleaning requirements



2 Burning bagasse successfully requires special furnaces. The Ward single-pass design fits into certain boiler types

FUELS AND FIRING

Utilizing Bagasse as Fuel, *by F X Gilg, Babcock & Wilcox Co.* Bagasse, the fibrous residue of crushed sugar cane, has been burned in a variety of furnaces, one of the most successful being the Ward single-pass furnace, Fig. 2. It usually consists of a horseshoe-shaped hearth with tuyeres in the walls. Bagasse feeds onto the hearth by gravity. The furnace has a high rear arch forming a throat above the hearth.

Paper describes and illustrates Ward furnaces fitted to: (1) a modern Stirling boiler with forced- and induced-draft and an air heater (2) a boiler with minimum baffling for successful natural-draft operation, and (3) an integral-furnace boiler with completely watercooled walls and floor, designed for firing bagasse, oil and gas. No. 3 unit is described in some detail, with a summary of operating experience and test results.

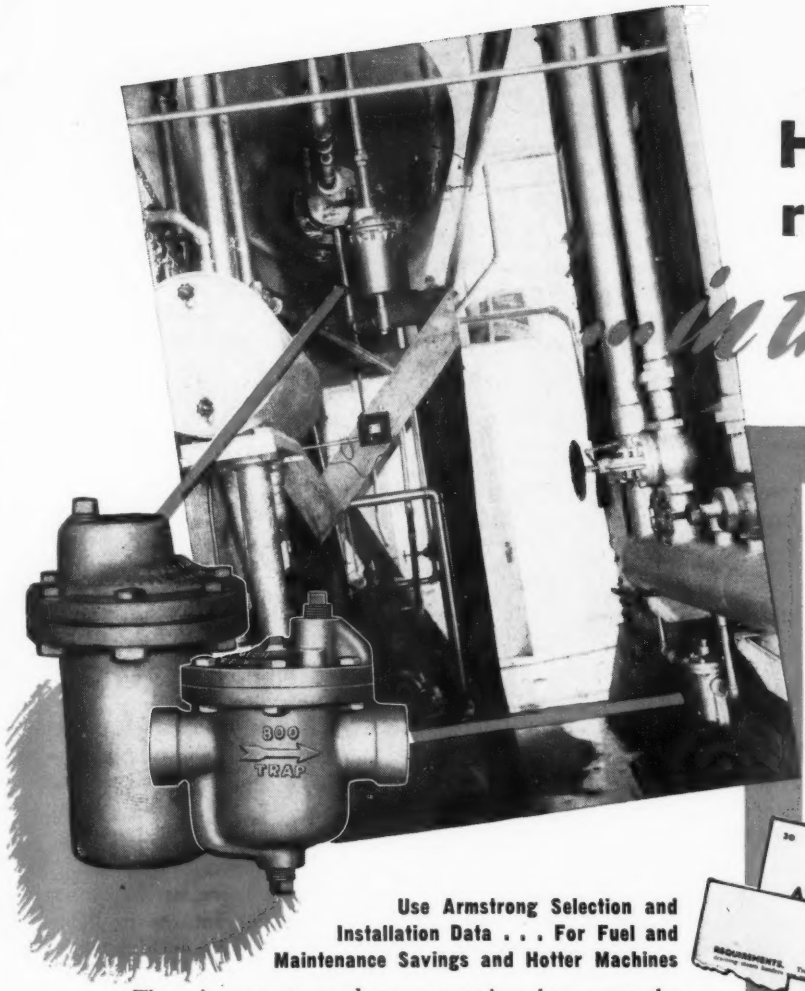
Also included are brief comments on partial drying of bagasse before firing and the possibility of burning such fuel pulverized. *ASME Paper No.* 48-S-3.

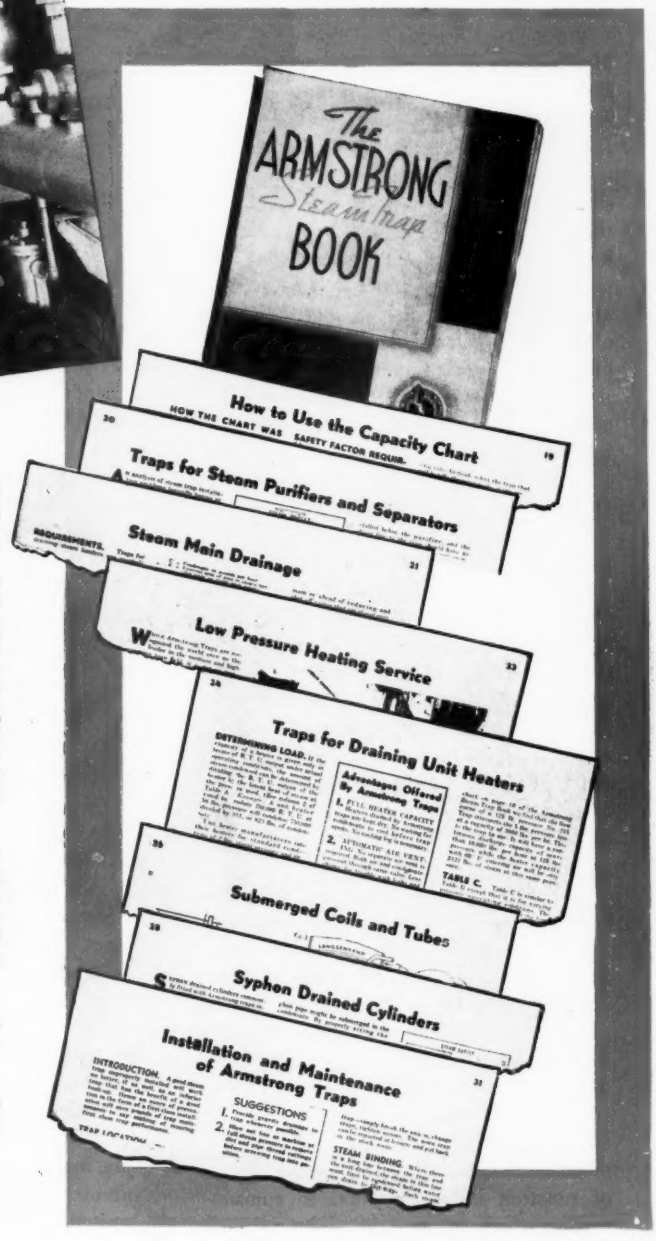
Developments in Kraft-Process Recovery-Unit Design and Performance, *by R K Allen, Babcock & Wilcox Co.* After reviewing the Kraft process of paper-making and the operation of the B&W-Tomlinson system for burning black liquor to recover useful chemicals and produce byproduct steam, paper cites recent design improvements leading to: (1) higher unit capacity and (2) reduced cleaning requirements.

Units with capacities of 275 tons per day are now in operation and two 350-ton-per-day units are under construction. A typical 275-ton-per-day design, Fig. 1, has a completely watercooled furnace, vertical 2-drum boiler and economizer, and tubular air heater.

Reduction in operating manpower has been obtained by changing heating-

How to get the right steam trap ...in the right place!

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There is more to good steam trapping than meets the eye. For example, intelligent trap selection involves not only the normal condensate load but must take into account peak load and the amount of air to be handled as well. The Armstrong Steam Trap Book tells how to figure condensate loads, what to do about large amounts of air and how to determine trap capacity needed for various services. It follows up with actual hot-condensate capacities of Armstrong traps. (Some trap capacity figures are based on cold water ratings, misleading because any trap will handle more cold water than it will hot condensate).

Then, because a properly selected trap won't function efficiently if it is not correctly installed, The Armstrong Steam Trap Book provides complete data on installation practice. But, even the Steam Trap Book can't think of *everything*, so the Armstrong factory and trained sales representatives stand ready to give you a lift on the really tough trapping problems.

These are a few of the reasons why Armstrong traps can be sold on a basis of "COMPLETE SATISFACTION OR YOUR MONEY BACK."

Send for a copy of the Steam Trap Book and plan now to modernize your condensate drainage system with Armstrong traps.

ARMSTRONG MACHINE WORKS
812 Maple St., Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

surface arrangement to reduce deposition of chemical solids and facilitate removal of solids that are deposited. Mechanical soot blowing can be applied successfully to clean the entire unit, eliminating crews for hand lancing. Parallel flow of air and gas instead of counterflow eliminates formation of hard chemical deposits in air heater.

Paper also presents economic factors influencing steam production and how they enter into over-all design of unit. *ASME Paper No.* 48-S-2.

Mechanisms of Combustion and Their Relation to Oil-Burner Design, *by H R Heiple and W A Sullivan, Shell Oil Co, Inc.* Combustion of fuels generally occurs in the vapor phase. To understand the combustion process the authors take up first a study of the kinetics of gaseous reactions.

Rate of reaction depends on temperature because collisions occur more often (proportional to the square root of the absolute temperature) and the percentage of molecules, possessing excess energy above the minimum needed, increases. Activation energy is expressed by $e^{-E/RT}$, where E and R are constants; T is absolute temperature.

Chemical reactions occur by one of two mechanisms, namely, thermal or chain. Thermal reactions involve molecular species only. Reactant molecules dissipate excess energy liberated by the reaction nonspecifically. Frequently this dissipation raises the temperature of the reacting mass, accelerates the reaction. If the initial temperature is above a certain value, reaction accelerates until the rate becomes infinitely large. A thermal explosion results.

Chain mechanism, the second path for reactions, has the initial reaction followed by a chain of successive ones. Sometimes resultant molecules transfer excess energy to one or another of the reactant molecules. This gives rise to a series of reactions. The reaction is described as an energy-chain one. Other chain reactions include as reactants atoms and radicals (metastable molecular species.) The over-all rate of reaction is proportional to concentration of chain carriers. The rate of formation or destruction of these carriers is most important.

With this background the authors study oxidation of hydrocarbons and in turn their properties as they affect burner design. Next, they discuss major burner types, how they fit theory developed. *ASME Paper No.* 47-A-34.

To Obtain Complete Text

Material in these briefs comes from one of two sources:

American Soc of Mechanical Engineers, annual meeting, Atlantic City, N. J., Dec. 1-5, 1947. Papers identified by initials ASME and paper No. preceded by 47-*A*.

American Soc of Mechanical Engineers, spring meeting, New Orleans, La., March 1-4, 1948. Papers identified by initials ASME and paper No. preceded by 48-S.

Available while supply lasts at American Soc. of Mechanical Engineers, 29 W 39th St, New York.

Synthetic Liquid Fuels in the United States, *by W C Schroeder, U. S. Bureau of Mines.* The disappearance of reserve capacity to produce natural crude oil in the U. S. is the most important difference between the country's prewar and postwar economic and security situation. Since the passage of the Synthetic Liquid Fuels Act in 1944 it has become increasingly apparent that the U. S. will turn to synthetic sources to augment its petroleum resources. Anticipated costs at the plant for products produced from, first, natural gas and, later, oil shale and coal, will run from 3 to 5c a gallon higher than the present prices. *ASME Paper No.* 47-A-40.

GAS TURBINES

Performance of Commercial Gas Turbines, *by Paul R Sidler, Brown Boveri Corp.* After reviewing experience with original 4000-kw standby installation at Neuchatel, Switzerland, and with 2200-hp locomotive unit of Swiss Federal Railways, paper describes and gives performance of several larger units tested and shipped in last year or so. Tests of 10,000-kw standby unit for Filaret Station, Rumania, show: (1) overload capacity to 12,000 kw at 68-F air-inlet temperature (2) ability to reach full speed about 5 minutes after starting motors are switched in, or 4 to 4.5 minutes after combustion chambers are ignited (3) ability to take full load as fast as load can be applied after speed has been reached, and (4) shutting-down time no longer than for steam turbines. Tests of generally similar unit for base-load service at Lima, Peru, show guarantee of 28% over-all thermal efficiency met by comfortable margin. Part-load efficiency for the base-load unit is definitely superior to that of peak load.

Tests of 4000-kw standby unit for Chimbote, Peru (POWER, Apr 1947, p. 228-9) again show better than guaranteed performance and indicate advances made since design of similar Neuchatel unit.

Paper also describes other current designs: (1) Two 4000-kw units for Southern Iran, using natural gas as fuel, employ a single-stage impulse turbine for starting. Expansion of gas, from well pressure of about 400-psi to 60-psi pressure of the combustion chamber, drives this turbine, which provides additional net power after starting is accomplished. (2) Sets of 13,000 and 27,000 kw (largest yet built) under construction for Beznau Station in Switzerland, where they will serve to back up hydro system in water-short winter months. Low inlet-air temperatures then prevailing give considerable added capacity; 13,000-kw unit is same as 10,000-kw design for normal air-inlet temperature, 27,000-kw machine is essentially the same as a 10,000-kw design doubled.

Paper concludes with reasoning behind adherence to relatively conservative throttle temperatures in light of lack of long-time data on high-temperature alloys. *ASME Paper No.* 48-S-7.

The Gas Turbine as a Stationary Prime Mover, *by L N Rowley and B G A Skrotzki,* POWER, *McGraw-Hill Publishing Co.* Because fuel cost and plant investment vary widely from place to place and time to time, comparison of gas turbines with steam and diesel plants is presented with these elements as variables. Curves show, for any given fuel cost and plant investment, the justifiable investment in the competing form of plant. These comparisons, for an isolated plant of 10,000 kw, are supplemented by an economic evaluation of gas turbines and steam plants, for both base and peak loads, as an addition to an existing system. This case study shows marked influence of the efficiency level of the existing system on the results. The gas turbine as a booster at the end of a transmission line is also evaluated.

To adapt the gas turbine to industrial power applications, provision for obtaining process heat is often necessary. Various possible modifications of the gas-turbine cycle to effect heat recovery are illustrated. Diagrams show possibilities of heat recovery at high temperature as well as at exhaust-temperature level. *ASME Paper No.* 48-S-5.

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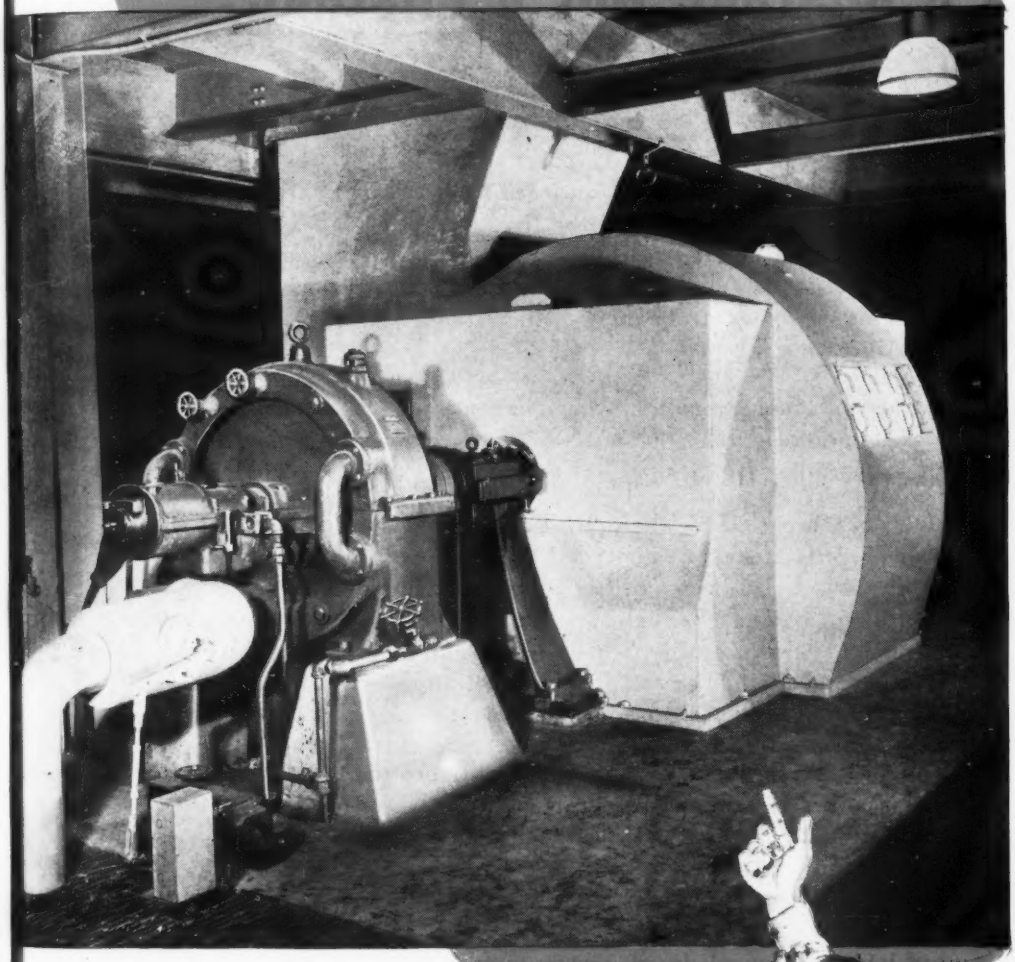

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EQUIPMENT FOR

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- ★ AIR TEMPERING
- ★ AIR WASHING
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"BUFFALO" INDUCED DRAFT FAN

"Buffalo" Draft Fans are built (1) to stand up longer, (2) to deliver air efficiently and (3) to permit quick inspection or replacement of all parts. For economy like this, specify "Buffalo". Your trained "Buffalo" representative will give you facts, or simply write:

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When Is a Mistake Not a Mistake?

"A mistake can never be one if you learn from it." How true a saying this is, considered in the light of the lives of men we all know. Ford, Diesel, Fulton, Edison and all the others made costly errors early in their efforts, which made them the laughing stock of their communities. But they profited from their mistakes and went on to score outstanding successes.

Look around among your co-workers, in your own plant. The men who are making progress aren't the ones who "never made a mistake in their lives." Rather, they are the ones who never make the same error twice.

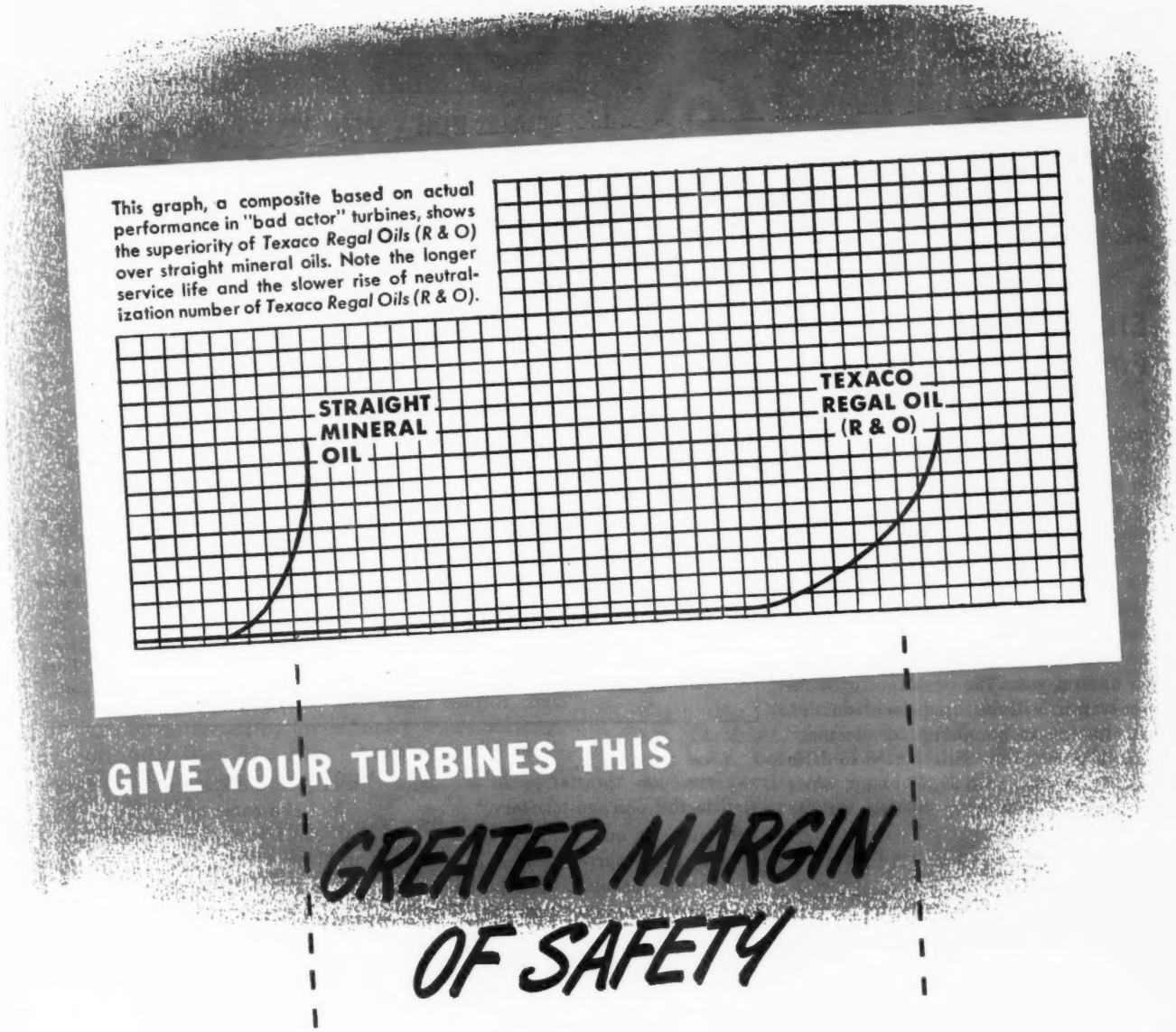
A friend of mine claims there are two kinds of mistakes: good mistakes and wrong mistakes. The good variety serve to steer him on to the right answer. He keeps a little black book in which he sets down the record of equipment failures, operating troubles—any data on plant blunders that he figures might have been prevented. He reviews this record frequently to make certain the same mistakes aren't being made again, and to check himself on proper precautions.

Wrong mistakes are the kind that happen more than once, and they seem to occur to the same people—the engineers who don't learn or who aren't interested enough. And have you noticed that most of the boys who keep on making the wrong mistakes can never be caught reading a technical magazine or book? They give the impression of knowing everything there is to know on all subjects, when in reality they stopped taking on knowledge many years ago.

So it pays to make a mental audit occasionally. Ask yourself if you have learned, in the past few days, a new procedure—another idea to make your plant more efficient—some thought for future application. If the answer is yes, you're not likely to find yourself bypassed when promotions are made. If the answer is no, you may have reached a plateau, which you've got to climb off. If you get rooted there, the only way off is down.

George Edwards

Engineer


This graph, a composite based on actual performance in "bad actor" turbines, shows the superiority of Texaco Regal Oils (R & O) over straight mineral oils. Note the longer service life and the slower rise of neutralization number of Texaco Regal Oils (R & O).
STRAIGHT MINERAL OIL
TEXACO REGAL OIL (R & O)

GIVE YOUR TURBINES THIS GREATER MARGIN OF SAFETY

CHANGES in operating conditions can adversely affect your turbine oil. But use *Texaco Regal Oils* (*R & O*) and you assure your turbines a greater margin of safety . . . because these fine oils contain special rust and oxidation inhibitors and are specially processed to prevent foaming.

A case in point. A 7500 KW turbo-generator ran satisfactorily on straight mineral oil for years. Then steam pressure was upped from 250 to 600 psi. Oil oxidation became rapid, and batches had to be replaced every 17 months or less. But since changing to *Texaco Regal Oil* (*R & O*) over three years ago, no oil change has been necessary, and the oil is still in good condition.

Texaco Regal Oils (*R & O*) keep lubricating systems clean and rust-free . . . assure instantly responsive governor action . . . keep bearings fully protected. They meet the stringent requirements of all leading turbine manufacturers, and the turbine oil specifications of the U. S. Navy.

Give your turbines this extra margin of safety. A Texaco Lubrication Engineer will gladly advise you. Just call the nearest of the more than 2500 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Regal Oils (R&O)

FOR ALL TURBINES

Tune in...Texaco Star Theatre every Wednesday night featuring Gordon MacRae and Evelyn Knight...ABC Network

POWER NEWS

BUSINESS ITEMS • APPOINTMENTS • FOREIGN FIELDS
WASHINGTON NOTES • NEW DEVELOPMENTS • CONVENTIONS

Elliott Receives Order For 40 Generators

▶ A CONTRACT of more than a million dollars to build 40 generators, each of 1100-kw capacity, was awarded recently to Elliott Co, Jeannette, Pa. These generators are to supply power for a new aluminum-producing plant of Aluminum Co of America at Point Comfort, Texas. They are for dc generation, but are provided with sliprings for an ac output of 150 kva. They will be driven by engines that are designed to operate on natural gas. The dc output of these generators will be used for reduction of alumina to aluminum by electrolysis. The ac output will be used to drive the auxiliaries, such as oil pump, water pump and scavenging blower, on the engines.

COMING EVENTS

July 12-21 — National Mechanical Handling Exhibition, National Hall, Olympia, London, England. Journal Mechanical Handling, Dorset House, Stamford St, London, S E 1, England.

Aug 2-6—Building & Maintenance Supplies Exposition, Grand Central Palace, New York, N. Y. Arthur Tarshis, president, 36 W 47th St, New York 19, New York.

Aug 23-26—National Assn of Power Engineers, annual meeting, St. Paul Auditorium, St. Paul, Minn. A F Thompson, secretary, 176 W Adams St, Chicago 3, Ill.

Aug 24-27—American Institute of Electrical Engineers, Pacific general meeting, Davenport Hotel, Spokane, Wash. H H Henline, secretary, 33 W 39th St, New York 18, N. Y.

Sept 14-17—New England Water Works Assn, exhibits and technical meetings, Hotel Pennsylvania, New York, N. Y. Arthur T Clark, secretary-manager, Water and Sewage Works Mfrs Assn, 170 Broadway New York 7.

POWER Editorial Staff Moves Ahead

As part of a continuing program to provide greater technical service to its readers, James J O'Connor has been added to the POWER staff, and Joseph C McCabe and Thelma Domb have been assigned larger editorial responsibilities.

O'Connor will specialize on electrical subjects. A graduate in electrical engineering of New York University, he has had extensive practical experience in construction, operation and maintenance of electrical equipment. After three years installing equipment and wiring for industrial plants, O'Connor spent seven years in the power department of the Board of Transportation, City of New York. Here he gained wide experience in operation, maintenance and supervision of automatic substations and power plants supplying the subway system. His intimate knowledge of motors, generators, breakers, relays and instruments qualifies him to bring to POWER readers the practical electrical know-how they want. He is the author of the special section on circuit protection in this issue. John L King, who formerly handled electrical material, has transferred to the sales staff in the Chicago territory.

Known to our readers as the co-author of the current series on smoke-prevention, Joseph C McCabe has been promoted from assistant editor to associate editor in recognition of his demonstrated ability to assume full responsibility for major editorial projects. An electrical engineering graduate of Lehigh, McCabe has had experience in sales as well as an all-round background as an operator in high-pressure pulverized-fuel and low-pressure stoker-fired plants. He has run the gamut from oiler, coal passer, pump man, turbine tender and fireman, to supervision of meter maintenance, station feedwater treatment, and general operating procedures. He holds a Class A Gold Seal operating engineer's license in the state of New Jersey.

McCabe came to POWER in 1945 and has since specialized in the technical problems of steam generation, combustion, fuels, and industrial-power practice. He is now covering heating, ventilating and air conditioning, as well. For the past two years he has been largely responsible for compiling POWER's Buyer's Guide and the annual tabulations of new steam-plant installations.

Thelma Domb is a graduate of New York University and has been associated with POWER for seven and a half years, first on the business staff and, since 1943, on the editorial staff. As Editorial Assistant she assumed responsibility for the New Equipment, New Bulletins and News departments. Her conscientious and skillful handling

(*Continued on page* 172)

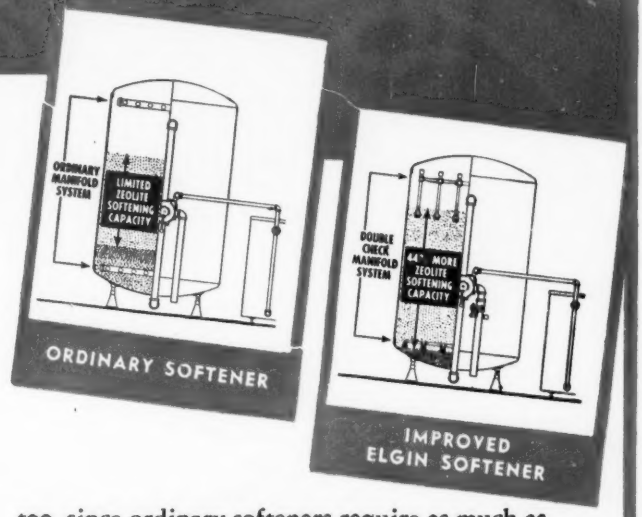
JOSEPH C McCABE

THELMA DOMB

JAMES J O'CONNOR

SEE FOR YOURSELF!

. . . how Elgin has revolutionized water softening



Prior to introduction of the improved Elgin, all zeolite water softeners were built basically like the ordinary unit here diagrammed. Note how the zeolite bed — the part that actually does the water softening — is comparatively shallow. This, in reality, was a compromise adopted as an attempt to limit the escape of zeolite during backwashing.

But now see how the present-day Elgin has changed the picture. By perfecting a new manifold system that prevents the escape of zeolite mechanically, Elgin has made it possible to utilize a far deeper zeolite bed. Coupled with the more efficient water distribution and zeolite regeneration made possible by this "Double-Check" Manifold, this deeper zeolite bed produces up to 44% more soft water output than can be delivered by an ordinary water softener of equal size. And this "Double-Check" principle is an Elgin development, fully protected by patents.

Obviously, in terms of soft water delivered, the Elgin way can reduce your original investment. It provides a more compact installation, too, since ordinary softeners require as much as 50% more space. And it keeps on saving over the years. The more thorough backwashing of the "Double-Check" system produces more zero-soft water per pound of salt, and keeps zeolite clean and active during a longer life. Prevention of zeolite loss means further economy.

Modernize old softeners, too

Your old softener, no matter what make, can be stepped up this new Elgin way. The "Double-Check" Manifold plus Elgin High Capacity Zeolite can mean as much as 44% more soft water output, at surprisingly low cost.

THE IMPROVED ELGIN GIVES 44% MORE SOFT WATER

The whole story is told in a new Bulletin that you will want to read. Ask for Bulletin 607. For hospitals, request Bulletin 608. For laundries request Bulletin 609.

NEED THESE CHEMICAL TREATMENTS TOO?

Elgin Post Treatment for softened water guards against boiler corrosion.

"Elgex" Treatment prevents corrosion in steam and condensate systems.

Elgin Inhibitant Treatment prevents and eliminates scale in hard water lines.

Elgin Anti-Corrosion Treatment prevents corrosion in hot and cold water lines.

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REPRESENTATIVES IN PRINCIPAL CITIES

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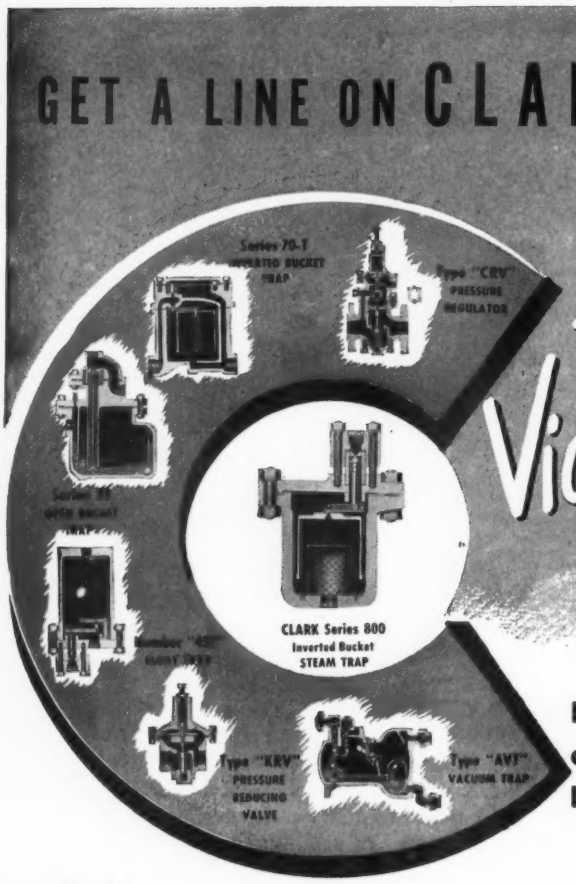

It Pays to Standardize on Clark–the Complete Line of Steam Traps!

40 YEARS OF EXPERIENCE PROVE THAT CLARK CONTROLS

Last Longer
Cut Maintenance Costs
Reduce Fuel Bills

If your production costs have been going up (and whose haven't) Clark can help you "hold the price line." The Heavier, Stronger construction of CLARK Controls makes for longer life and less frequent replacement. Our Engineering Department stands ready to help you on all fluid control problems.

Write today for details.

Write today for this free, helpful guide to more economical controls for your oil, steam and air lines.

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1831 East 38th Street • Cleveland 14, Ohio

Clark
THE COMPLETE LINE OF
FLUID CONTROLS

Waste-Heat Boiler

(*Continued from page* 100)

The same quantity of additional fuel is needed to produce the additional steam regardless of which system is used. The auxiliary burner requires a separate fuel system, primary air supply and provision for introducing the burner just ahead of the boiler. The boiler limits the firing temperature and not the turbine. The boiler may be either a fired or unfired pressure vessel.

The throttling system needs a controlled throttling valve in the turbine exhaust. Since the additional fuel is burned in the turbine combustors no additional fuel or air supply is needed. Maximum gas temperature entering the boiler is controlled by allowable exhaust temperature. The boiler is an unfired pressure vessel.

Application. This application of a waste-heat boiler will undoubtedly meet with wide acceptance in both central station and industrial-power fields. This arrangement can fulfill the requirements of almost any industrial process where large quantities of process steam are needed in addition to electric power.

In addition to being good for continuous duty, the gas turbine should be excellent as a standby unit or for peak-load service where it could be used with a waste-heat boiler. The steam generated could be used in existing turbines that might be outdated for continuous service, but usable for short-time operation. This would mean 1500 kw more of electrical power without additional steam-turbine investment costs.

There are many old power plants with boilers that are being derated. Some of these could be used with minor alterations as waste-heat boilers for gas turbines, thereby eliminating waste-heat boiler investment.

Mechanical Drive

(*Continued from page* 106)

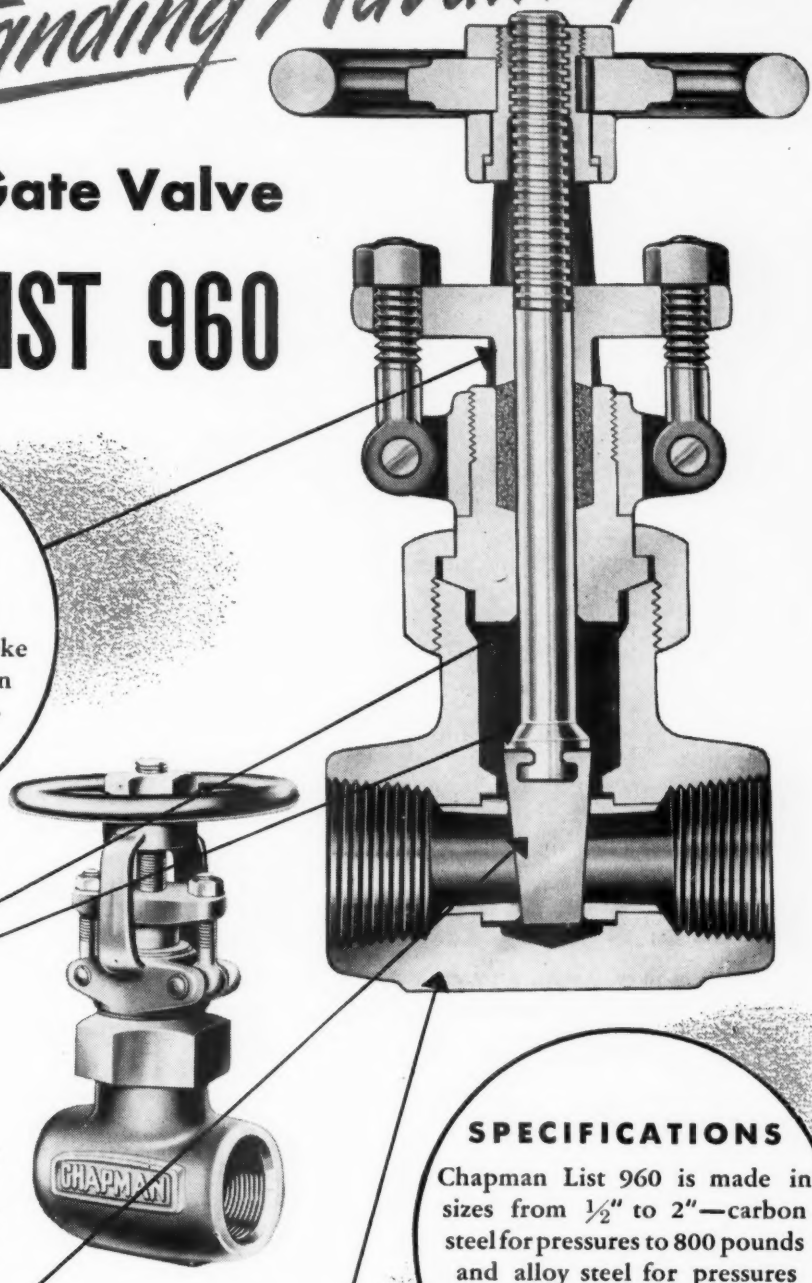
ible and entirely automatic. Some regulators are connected within the governing system, where they regulate speed directly. With other types connection is made to the stem of the governing valve; thus the regulators set valve position. With the latter arrangement the lower speed limits of

CHECK THESE

4 Outstanding Advantages

of this Sturdy Gate Valve

CHAPMAN LIST 960



1.

FORGED STEEL PACKING GLAND

Protects threads on valve yoke from rust and corrosion when valve is used in exposed locations.

2.

FULL PRESSURE PACKING

This valve can be repacked under full pressure because no pressure is transmitted to the valve stem.

3.

MALCOMIZED STAINLESS STEEL PARTS

All stems, plugs, and seat rings are made of Malcomized stainless steel—for extra-severe services.

4.

RUGGEDLY BUILT BODY

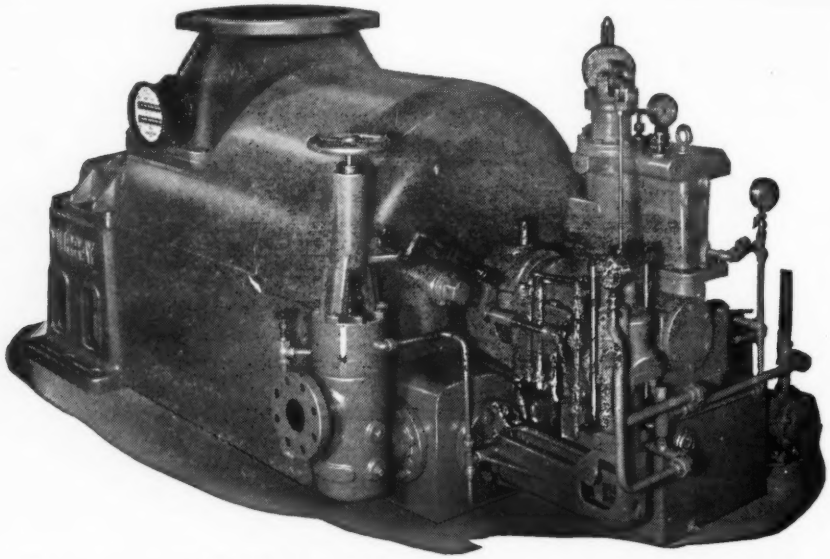
Made of strong forged steel.

SPECIFICATIONS

Chapman List 960 is made in sizes from ½" to 2"—carbon steel for pressures to 800 pounds and alloy steel for pressures to 1,000 pounds, at 750°F. For higher pressures, specify List 990.

The Chapman Valve Mfg. Co.

INDIAN ORCHARD, MASS.



One of two MURRAY multistage steam turbines, designed to deliver 685 horsepower on steam at 110 pounds and exhausting to 26½ inches Hg vacuum, furnished to drive high speed centrifugal compressors for refrigeration in one of the most prominent Southern Hotels. A third unit has recently been shipped. Equipment includes variable speed oil relay governor, trip and throttle valve, strainer surrounding the double seated balanced governor valve, and force feed lubrication.

MURRAY
MULTISTAGE
STEAM TURBINES

★ ★ ★ ★

The complete MURRAY line of steam turbines includes all variations of mechanical drives, and turbine generator sets up to and including 3000 KW rating.

Sales Representatives for Murray products are located in all principal cities.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

smaller turbines can be extended. This permits standard units to be used in applications requiring long speed ranges.

Backpressure and inlet-pressure governing can be provided where speed can be held by means other than governor control—either a connected motor or generator.

For the common pump, fan or blower drive, the characteristic of the greatest importance is adjustable speed range. Regulation and speed variations are measures of accuracy of control. These are important in drives for paralleled generators, generators subject to load swings, paralleled compressors, paper machines, textile ranges, testing equipment, etc.

In some applications, particularly for high steam conditions, high flows, and large ratings, only oil-relayed or electric governors are applicable, since valve movement may require use of a force greater than that available from the simpler types of governor.

Special Features. Since turbines are used for a great variety of applications, it's impossible to specify a set of features covering all conditions. For this reason several special features are offered as modifications to the standard basic designs. Table II lists the more important features. Table III lists the various accessories that may be needed on turbines.

Electronics

(*Continued from page* 112)

diagrams the simplified circuits for a grid-controlled high-vacuum tube. These connections are the same as in Fig. 8, except the grid and its battery have been added.

Since the grid connects to the negative terminal of its battery, it has a negative polarity, the same as the electrons from the cathode. Consequently, the grid opposes the flow of electrons from cathode to anode. If negative voltage on the grid is made sufficiently high it reduces to zero current flow through the tube. Then, by moving the contact to the right, along resistor R, negative potential on the grid is reduced and current flow through the tube increases.

At zero grid potential, current flow through the tube is practically the same as if the grid did not exist. If grid polarity is made positive it further increases current flow through the tube. Curve in Fig. 16 indicates how current may vary through a vacuum tube under grid control. Starting with 15 v minus

DEATH MAKES A HOLIDAY...*

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"No classes tomorrow!" . . . but there's no joy in the saying. Just small huddled forms, so strangely silent. Someone forgot that uncontrolled pressure can create havoc. Someone hadn't heard about Black, Sivalls & Bryson SAFETY HEADS.

This same overpressure in your industrial plant could take the lives of your employees . . . cause damage amounting to thousands of dollars.

Inquire today from your Plant Engineer if the lives of your personnel and your plant investment are protected with BS&B SAFETY HEADS against disastrous explosions that might result from overpressure.

In the 100,000 plants where SAFETY HEADS are used, no pressure vessel equipped with a SAFETY HEAD has ever exploded. Address your letter to Industrial Power Department, Special Products Division, Black, Sivalls & Bryson, Inc., 27th Floor, Power and Light Building, Kansas City 6, Missouri.

* Illustration is an artist's conception of an actual explosion of a school building which resulted in loss of life and extensive property damage. A Black, Sivalls & Bryson SAFETY HEAD, costing only $22.82, would have prevented this explosion.

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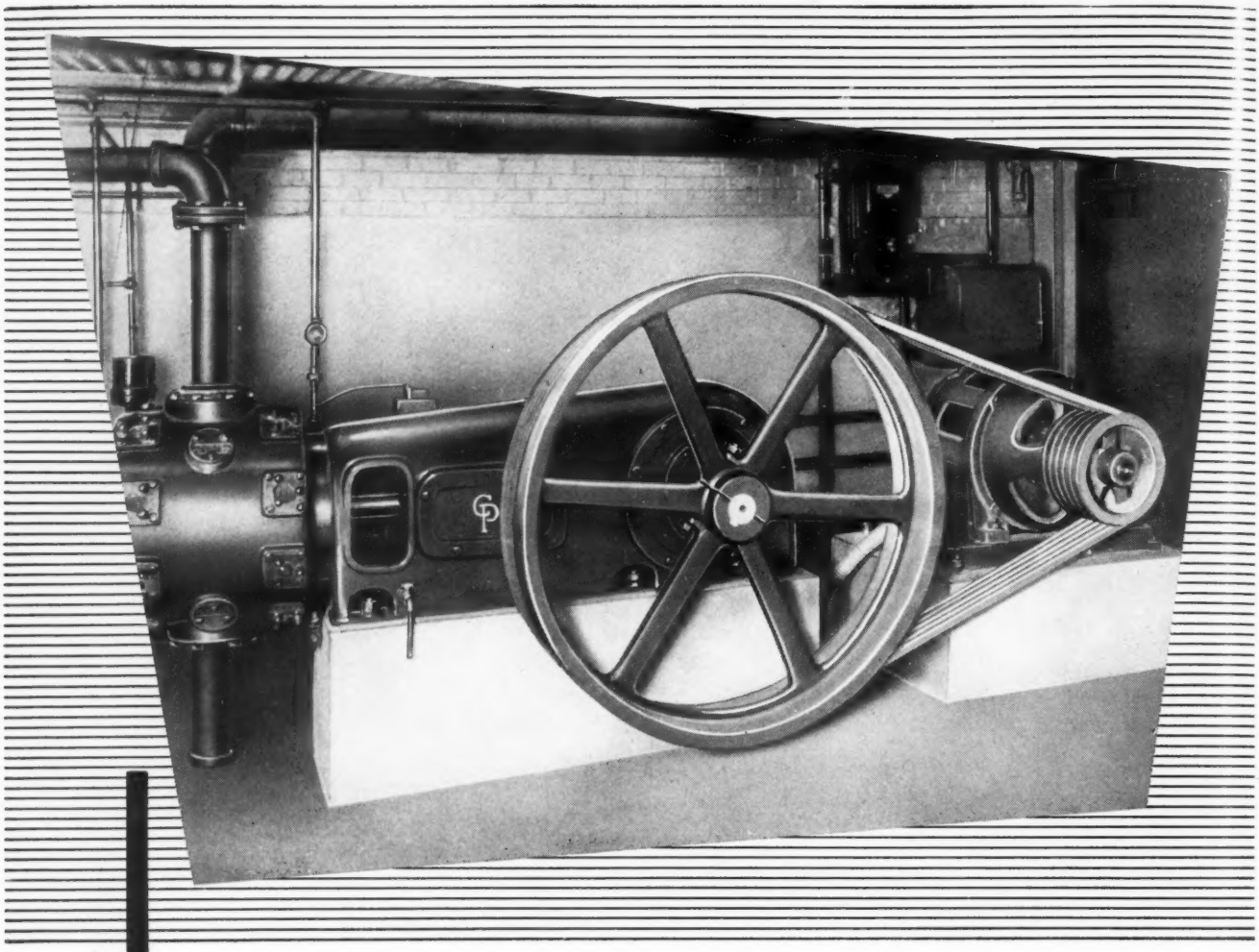

For a dependable and economical air supply

The Type TB horizontal, straight-line, double-acting compressor has proved its dependability through years of satisfactory service. Moderately rated, it can always be counted upon for continuous, economical operation, low maintenance, and long life.

Simplate valves . . . liberally water-jacketed cylinder and heads . . . adjustable, tapered roller main bearings . . . double-counter-weighted crankshaft . . . are some of the CP features that have made it outstanding.

Type TB Compressor is furnished in sizes from 89 to 1937 c.f.m., with V-belt, flat belt, and direct-connected synchronous motor drive. Single and multi-stage designs for pressures up to 5,000 pounds, and steam-driven types are also available.

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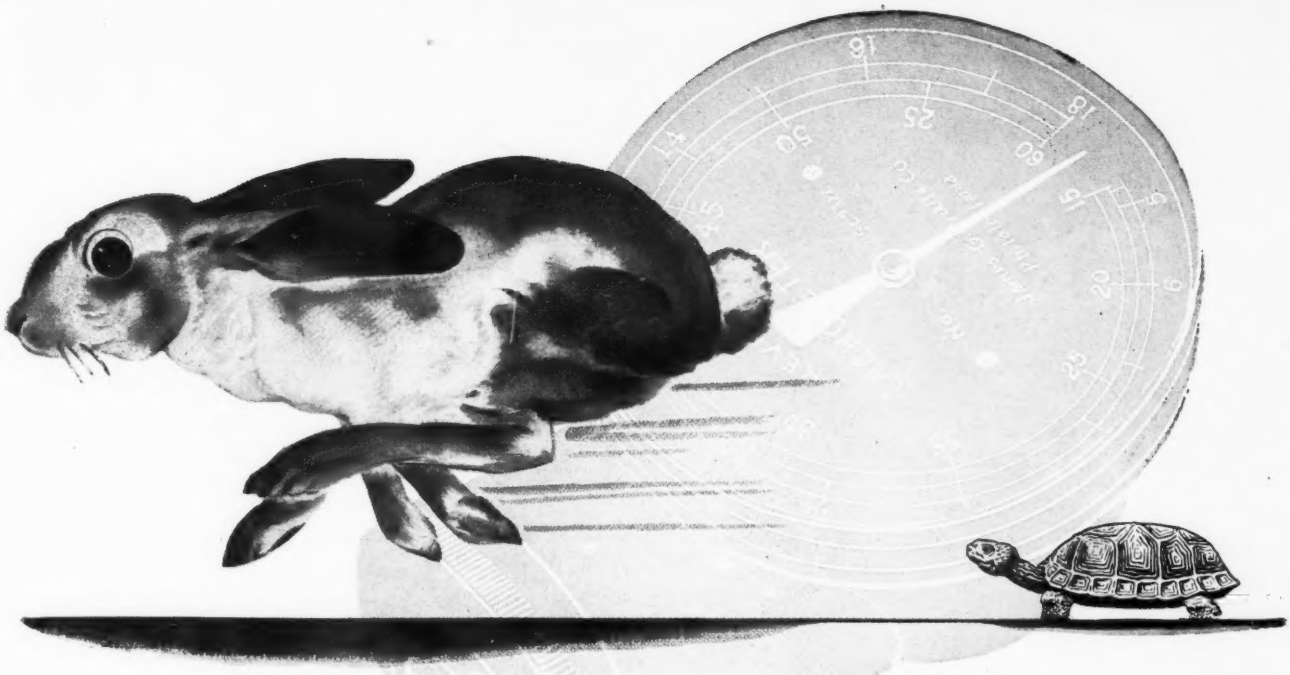

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. . . in speeds to be measured.

And we have instruments to help solve *your* speed-measuring problems accurately . . . dependably.

Covering a wide range of speeds, each Biddle Instrument is designed to do a specific job . . . and do it well. Included among the Biddle line are:

- "FRAHM" Resonant-reed Permanent Mounting Tachometers
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- "JAGABI" Tachoscopes
- "JAGABI" Type-A Tachometers (centrifugal)
- "JAGABI" Speed Indicators (chronometric)

Accuracy . . . dependability . . . ruggedness . . . these are the built-in advantages that you get with every Biddle Instrument . . . advantages equally important in the field, in the laboratory, or on the production line.

The Biddle Instruments listed above and many others are described fully in Bulletin 35-P. We will be pleased to send you a copy.

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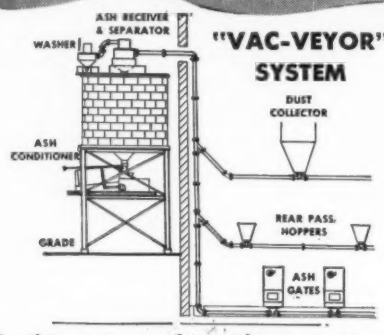
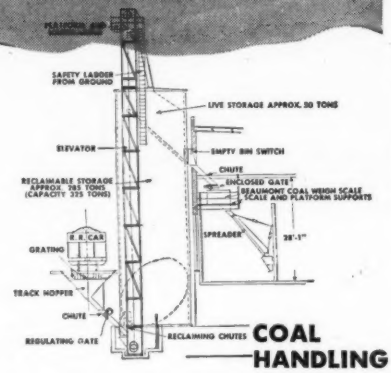


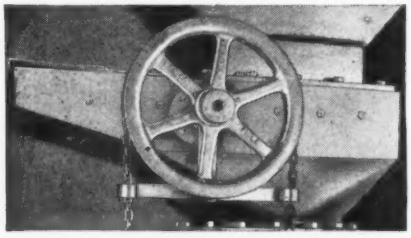
"VAC-VEYOR" SYSTEM

In this system, ashes, siftings, soot and dust are conveyed by pipe from the ash pits, dust collectors, stack, etc., to an ash receiver and separator at the top side of a silo—by means of a vacuum. One man operates the system, keeping your plant cleaner with less labor.



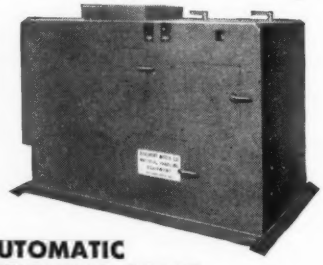
COAL HANDLING

Coal arrives by rail, is dumped into hopper, raised by bucket elevator and discharged either into bunker for immediate use or down chute to yard storage. One operator controls all equipment.



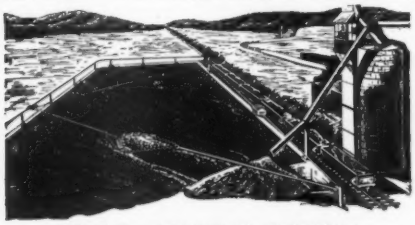
ROLLER BEARING GATE

Incorporating double rack and pinion for granular or powdered materials, these drip-proof self-cleaning gates will not corrode, bend or warp. Material cannot collect in back of gates—these ball bearing gates operate manually or electrically without strain or ramming.



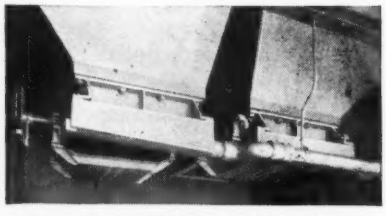
AUTOMATIC WEIGHING SCALE

Accurately weighs coal and similar materials from 1 to 60 tons per hour. Vibrating feeder plate eliminates belts, pulleys and motors. Scale is totally enclosed, dustproof and quiet.



DRAG SCRAPER SYSTEM

Coal is dug evenly with minimum power consumption. Tail blocks can be slung between posts and moved by hand, mechanically moved on I-beam track by tail block car, or suspended from aerial bridge system. One man can operate entire system by remote control.



ASH HOPPERS AND GATES

Steel plate ash hoppers are low cost, rigid, unbreakable, watertight and, when lined with refractory material, resist temperature and erosion. Ash gates are designed for use on stoker and pulverizer ash hoppers where water sealing and draining is essential.

Beaumont engineers design and erect this and associated equipment—*a complete coal and ash handling system.* You save in installation as well as in handling. ONE CONTRACT—ONE RESPONSIBILITY—FOR BULK HANDLING SYSTEMS. Write for more information to:

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Designers *Manufacturers* *Erectors* BULK MATERIAL HANDLING SYSTEM

on the grid we have zero anode current. At zero grid volts, anode current is 10 milliamperes. As grid potential increases to 15 v plus, anode current rises to 27 milliamperes. Thus, by varying the potential on the grid, tube output can be varied over its entire range.

Voltage on the grid may be a faint signal only, such as a radio wave, or a potential up to 50 or 60 v, depending on tube size, its anode volts and application. A gas-filled tube under grid control acts somewhat differently from a high-vacuum one, as we will explain in a later article.

In a 3-element tube we have anode, grid and cathode with insulation (space) between them. Therefore, they form an electrostatic condenser that may interfere with control of the tube input. Also, voltage drop through the tube with certain load types may limit its use.

To overcome these limitations a second grid, known as a screen grid, is added to the tube, making it a 4-element unit, called a tetrode. The screen grid, which may be similar to the control gird, is placed between the control grid and the anode, Fig. 17. It is given the same polarity as the anode but a lower potential.

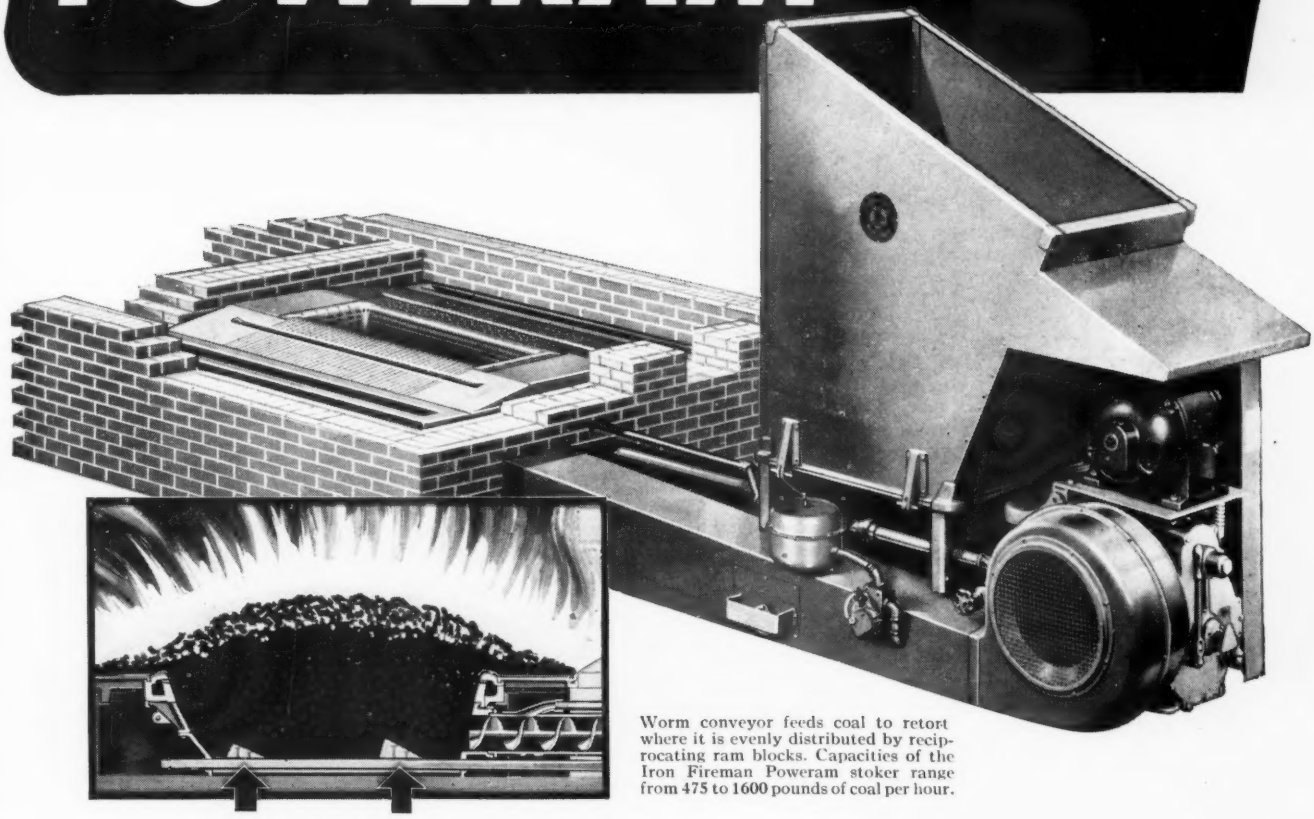
When the anode is bombarded by high-velocity electrons from the cathode the anode may also emit electrons. Known as secondary emission, this action has a tendency to retard electron flow from the cathode. In the diode and triode all electrons of secondary emission are attracted back to the anode. Therefore secondary emission has practically no effect on anode current.

In the screen-grid tube (tetrode) if the screen potential happens to become higher than that of the anode the screen attracts the secondary emission electrons, and may seriously affect the anode-current flow. To overcome this effect in some tubes a suppressor grid is placed between screen grid and anode, Fig. 18. The suppressor grid is usually connected to the cathode within the tube to give it a potential that returns the secondary electrons to the anode. Such tubes are known as pentodes because they have five elements.

Fig. 22 shows the arrangement of elements in one design of pentode, with cathode *C*, control grid *G*, screen grid *S*, suppressor grid *P* and anode *A* clearly marked. The anode made of graphite connects to a terminal in the tube top.

The thermionic tubes described are those most generally used for industrial purposes. They often have different trade names or are named for the pur-

IRON FIREMAN POWERAM STOKER



Sliding Distributor Blocks

Worm conveyor feeds coal to retort where it is evenly distributed by reciprocating ram blocks. Capacities of the Iron Fireman Poweram stoker range from 475 to 1600 pounds of coal per hour.

Highest Development of the Underfeed Stoker

The Iron Fireman Poweram stoker is designed to fire a wide range of coals, including the heavy coking types, *efficiently* and *automatically*. It combines the best features of both ram and screw type stokers. Coal is delivered to the retort by worm conveyor—loose, unpacked, easily aerated. Sliding wedges in the bottom of the retort produce an undulating motion of the coal that keeps the fuel bed loose and open. This makes possible the successful use of a wide range of economical coals.

The POWERAM stoker is but *one* example of Iron Fireman's advanced engineering. The complete Iron Fireman line includes stokers for every type and size of firing job.

No matter what your firing needs may be, there's an Iron Fireman stoker to meet your exact requirements. Write for Poweram catalog to Iron Fireman Manufacturing Company, 3228 West 106th Street, Cleveland 11, Ohio. Other plants in Portland, Oregon; Toronto, Canada. *Dealers everywhere.*

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AUTOMATIC FIRING

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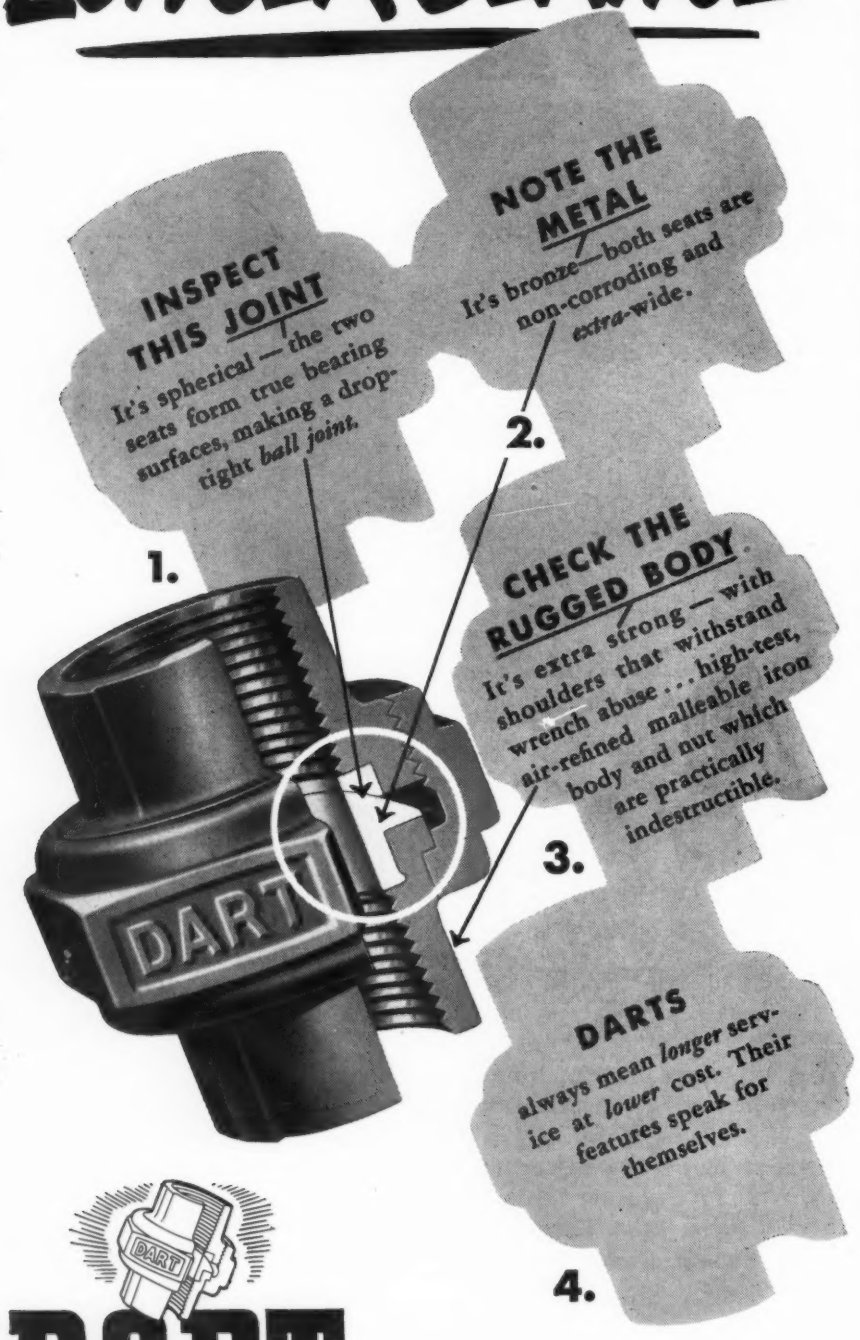
INSPECT THIS JOINT
It's spherical — the two seats form true bearing surfaces, making a drop-tight ball joint.
1.
NOTE THE METAL
It's bronze—both seats are non-corroding and extra-wide.
2.
CHECK THE RUGGED BODY
It's extra strong — with shoulders that withstand wrench abuse . . . high-test, air-refined malleable iron body and nut which are practically indestructible.
3.
DARTS
always mean longer service at lower cost. Their features speak for themselves.
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pose they are used for. We will consider them in later articles. They are also special tubes such as X-ray, cathode-ray, electron-ray, magnetrons and others that we do not have space to consider.

There are also cold-cathode tubes in which the cathode is not heated, the electrons being pulled out of it by applying a sufficiently high voltage from cathode to anode. A glow tube and a radiatron are gas-filled tubes of this type without a grid where a grid-glow tube has a cold cathode and a grid, and is gas filled. Filling the tubes with gas at a low pressure reduces the voltage at which electron discharge occurs between their cathodes and anodes. In some cold-cathode gas-filled tubes breakdown voltage may be as low as 125.

Since anode and cathode in cold-cathode or glow tubes have the same temperature these tubes tend to pass current as freely in one direction as in the other. They are made to conduct more readily from cathode to anode by making the cathode much larger than the anode.

Cold-cathode tubes also have a grid to control their output, as in Fig. 21. In this design the cathode is a comparatively large metal cylinder where the anode and grid are small wires. These tubes are known as grid-glow tubes. Their grid is more correctly called a starter, because it is used to start the tube conducting rather than control current flow after it starts.

In one circuit arrangement a voltage less than breakdown potential is maintained between cathode and anode. This voltage exceeds breakdown value when the starter is energized so, when a suitable voltage is applied to the grid, current flows between cathode and anode.

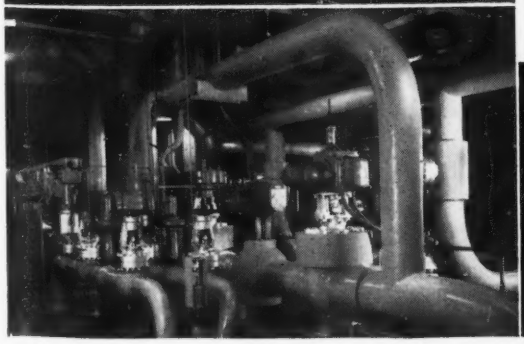
Fig. 19 is the symbol for a glow tube, and Fig. 20 for a grid-glow tube. Both classes of tubes are gas filled. A feature is that they maintain practically constant voltage across their terminals regardless of current flow through them, up to their safe rating. This characteristic permits their use as voltage regulators in electronic circuits.

Plant Problems

(*Continued from page* 130)

end of actual expansion line, and one drawn through an intermediate point. If valve setting for point of cutoff were known, it would be possible to say

COMPLETE PIPING SYSTEMS *from Blueprint to Erection!*



Pittsburgh Piping and Equipment Company assumes complete responsibility for a high temperature, high pressure piping system . . . beginning with the blueprint and ending only when the system is installed. By placing this responsibility in the hands of a specialist you obtain the advantages of a distinctive engineering technique, specialized manufacturing facilities, broad experience in diversified piping applications, and skill in meeting and solving present-day erection problems. You are relieved of the thousand-and-one details that are part of today's fabricating and erecting problems—and assured of a lastingly reliable and efficient piping system. Consult our nearest representative for further particulars.

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For example, by closer control of a quenching bath, it has helped make possible continuous production of precision parts with rejections reduced to the vanishing point and production over double previous performance.

Other applications are cooling of process equipment and engine jacket water, cooling of lubricants, cutting oils, hydraulic oils, electronic sets, transformers, controlled atmospheric processes, condensing of steam, gases and refrigerants, compressed air and gas cooling.

Write for further information and examples of applications in the field that interests you most.

Ask for Bulletin 96-P.

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which curve is closer to the truth. Lower curve has a cutoff at about the same relative point as the head end; if diagrams were taken under the same load conditions, this curve is probably correct. Stated mep for the crank end, however, is so much larger than the head end that it would appear the point of cutoff must be later, which would make top curve correct. Based on the lower *PV* curve, steam valve leakage is extremely bad. The indefinite point of cutoff also indicates some throttling through the steam valve.—**W L Govan, Ontario, Canada**

Valve-Rod Adjustment May Cause Pound

INDICATOR CARDS show a decided unbalance in the power developed by the two ends of the cylinder in *AJS's* engine, one end developing about 40% more power than the other.

Both cards show the eccentric should be advanced slightly as evidenced by inward slant of admission lines near upper ends. Expansion line on the head-end card is good and shows reasonable cutoff and a tight valve. Expansion line on crank-end card shows poor valve action of both intake and exhaust. Inlet is either leaking or cutoff is late in the stroke, as shown by hump in expansion curve about midway of its length. Crank-end exhaust valve is opening early, as evidenced by the relatively high pressure at end of expansion line. If valve rod is improperly adjusted, it causes this valve to close late, and account for pound.

I suggest *AJS* check his eccentric to be sure it has not slipped on shaft, and also reset valves and check valve-rod adjustment. In any event, power developed on the two strokes should be balanced for engine efficiency.—**W R Kilbourn, Boston, Mass.**

Possible Causes and Remedies Outlined

STEAM END of a blowing engine requires little or no compression at end of piston stroke since highest pressure in air cylinder occurs simultaneously, and effectively cushions the reciprocating parts upon reversal of stroke.

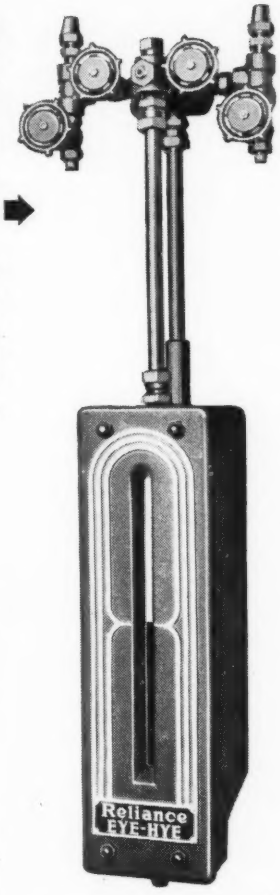
Possible causes of pounding in *AJS's* engine, however, are: (1) loss of cushion in crank end of air cylinder caused by a leaking stuffing box, leaking piston rings, leaking air-suction valves or plugged suction valves. (2) excessive compression in crank end of air cylinder caused by too early closing of air-discharge valves or by plugged dis-

It takes *Team Work* to prevent boiler accidents

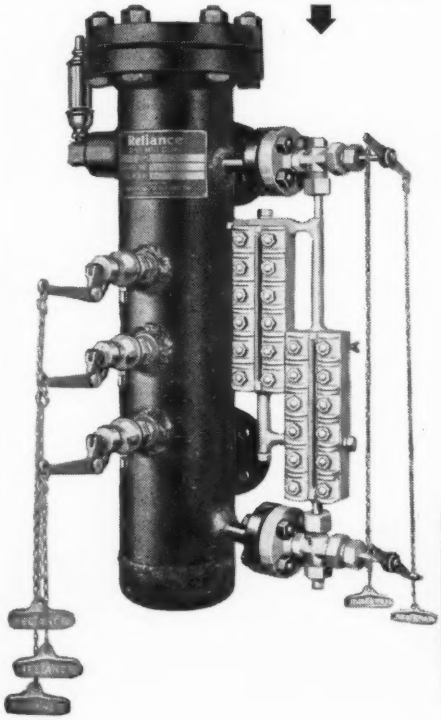
Reliance Safety Team

helps you to achieve efficient power production free from costly shut-downs due to water-level failure . . .

Reliance EYE-HYE Remote Reading Indicator. Reading accurately at eye height at a prominent convenient point—perhaps right alongside instruments on your panel—EYE-HYE provides a sharply visible sight check denying any argument that water gages are "hard to see."



Reliance Alarm Water Column. This faithful sentinel at the boiler drum responds to less than a quarter inch change in the water level—sounds its shrill whistle when the level approaches points too low or too high for safety.



YOUR casualty insurance man will tell you that boiler accidents still happen—far too many of them—in spite of modern controls and instruments. Extra *preventive* insurance—the Reliance Safety Team—that will serve you faithfully for many years, can be had for very small cost compared to the major equipment it protects.

No amount of *equipment* entirely offsets factors such as ignorance, carelessness and indifference on the part of operators. It takes *teamwork* between men and devices to prevent the accidents that kill or injure employees, damage property, and cause large losses through plant shut-downs. That is your management problem. But if your men can *hear* and *see,* their attention to the water level information supplied by the Reliance Safety Team will prevent boiler water level accidents.

Safe efficient water level supervision is achieved in thousands of power plants with the help of Reliance Boiler Safety Devices—made by the oldest exclusive manufacturer of boiler water columns and gage equipment. Ask your nearest Reliance Representative, or write to the factory.

BOILER SAFETY DEVICES since 1884

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TROY-ENGBERG STEAM ENGINE

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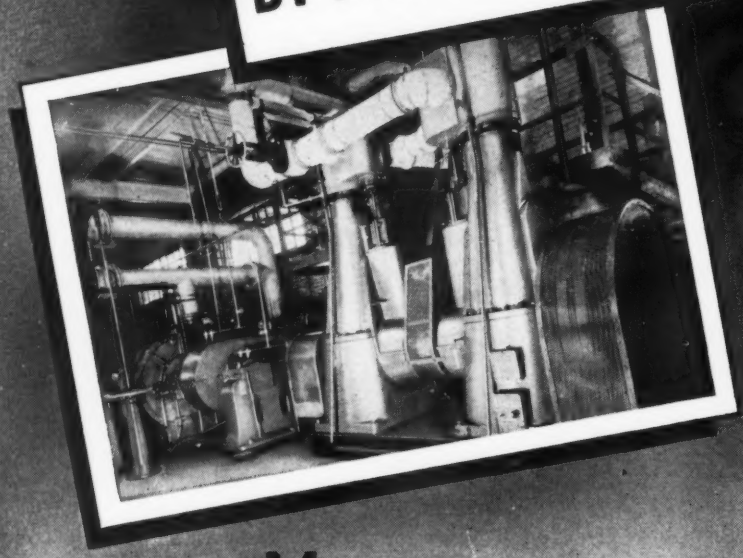
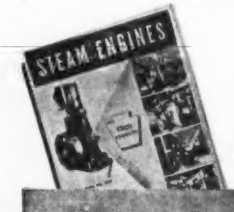
BY USING
BY-PRODUCT POWER



Make your STEAM do two big jobs . . . eventually one of them at little or no cost. With proper heat balance your steam can provide—FIRST, power for driving equipment, and SECOND, heat units needed for processing or heating.

Use boiler steam to run a Troy-Engberg Steam Engine. THEN use the exhaust in your heating or processing lines. Drive your pumps, stokers, generators, blowers or compressors with By-Product Power. Use a Troy-Engberg Steam Engine as a reducing valve and your power cost saving will pay for the engine in a very short time.



Send for Bulletin 306

TROY ENGINE & MACHINE COMPANY
Established 1870
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STEAM ENGINES • GENERATING SETS • GENERATORS

charge valves. (3) unequal distribution of work between crank and head ends of steam cylinder caused by a slow-acting dashpot or by a leaking crank end steam valve. (4) excessive clearances on crankpin and crosshead bearings caused by changing the brasses, but not properly fitting them to the worn pins.

Causes (1) and (2) may be detected by reference to indicator diagrams taken from air cylinder, followed by inspection of air-valve chambers for evidences of broken or plugged valves. Cause (3) requires inspection of dashpot mechanism for evidences of a plugged air-release port, a broken return spring or an air leak into the vacuum chamber. Steam valve should be removed and edges of valve and seat inspected for erosion caused by accumulations of water in cylinder or valve chest. Check operating methods to determine if cylinder and steam chest are properly drained before starting the engine. Cause (4) requires that leads be taken from crankpin and crosshead bearings for checking clearances. These clearances should be about one thousandth of an inch per inch of pin diameter. Total clearance may be reduced slightly if the brasses are scraped to a good bearing on the pins.

After making inspections and tests outlined *AJS* should check his valve settings with the manufacturer's marks—**—Milton N Kraus, Sunnyside, L. I.**

Check Nut on Piston Rod

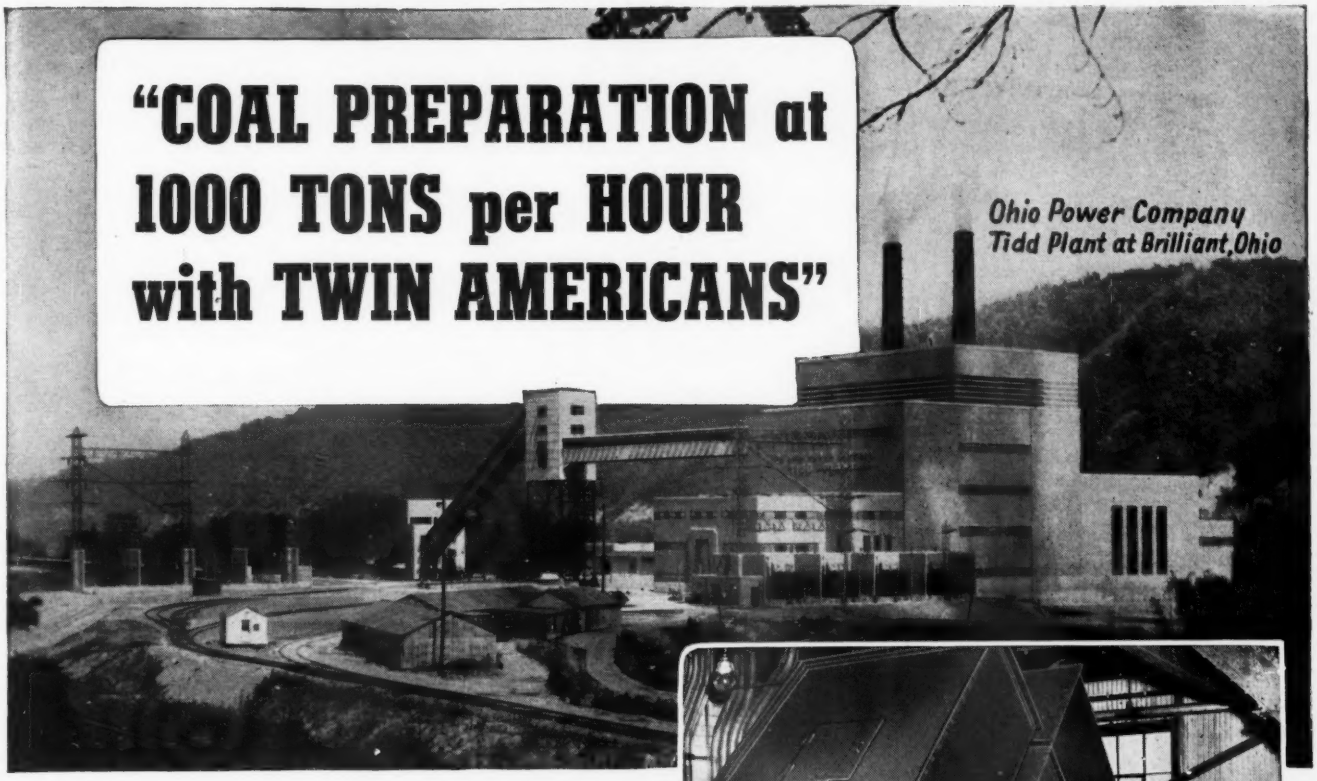
WE HAD a vertical corliss engine in 1925 that pounded badly on bottom center. At times it pounded on every revolution and then ran quietly for several seconds. Occasionally it pounded every other revolution for minutes at a time.

Investigation showed there was insufficient thread on the piston rod, and bottom side of nut did not actually bear on the piston. Since the nut was counterbored into the piston, one could not see when it came into contact and its tightness on the thread was mistaken for its bearing on the piston. I suggest *AJS* check this point.—**C A Wilkes, Oaklyn, N. Y.**

Advance Eccentric To End Pounding

INDICATOR CARDS taken by *AJS* show the reason for engine's pounding. If it weren't a vertical unit it would pound on top center as well as bottom; weight of the line of parts stops that.

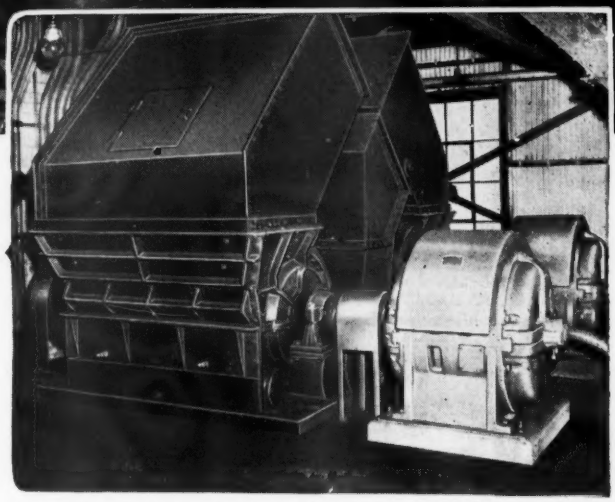
Both ends of cylinder show late steam and exhaust timing, which means that



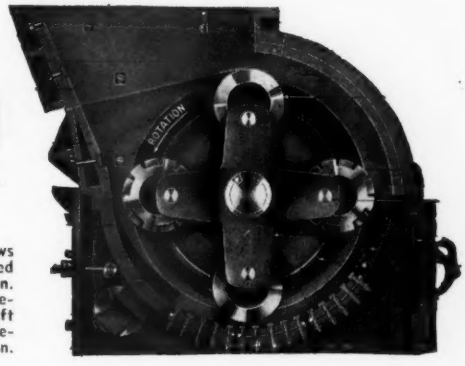
And the Complete Crushing Units Occupy only 12'x12'x12'

110,000 kilowatt output represents converting 1200 tons of coal per day into power . . . Continuous pulverizer feed from bunkers kept at constant level of ¾" by conveyors from the two "Type S No. 60" American Ring Crushers which reduce the 16" ROM bituminous coal. Direct-connected with two 200 HP 720 RPM motors, the Americans employ efficient shredder ring action with an unusually conservative power demand.

The uniform product and the dependability of Americans are considered essential to the unfailing, high output of the Ohio Power Co. and other power plants throughout the world. Americans offer a complete crushing plant in one compact unit,—no auxiliary crushers or refuse picking operations are required.



Note the compactness of area and headroom in which these two direct motor-connected Model 60S Americans are installed including by-pass between.



Cross - section shows Americans patented shredder ring action. Each shredder ring revolves on its own shaft and automatically deflects from tramp iron.

Send for the facts on efficiency of coal preparation in power plants with American Crushers.

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Originators and Manufacturers of Ring Crushers and Pulverizers

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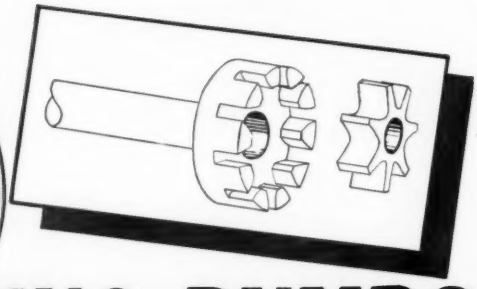
2 Good Reasons for Dependable VIKING PUMPS



These simple 2-moving parts with their *CORRECT* application and engineering have meant good reliable pumping for over a third of a century. They give you these outstanding features:

Self priming.
Constant, even discharge.
Low speed—long life.
Low power requirements.
Suitable for any clean liquid (heavy or light)
Discharge pressures up to 200 psi.
No timing-gears, springs or gadgets.
Complete capacity and model range available.

Look to Viking to fill your pumping requirements.

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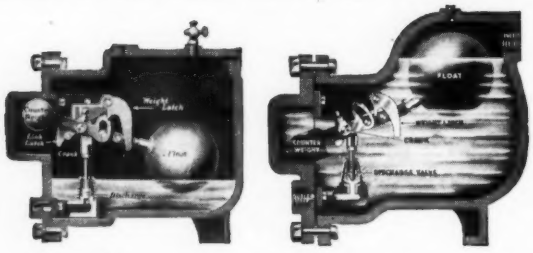
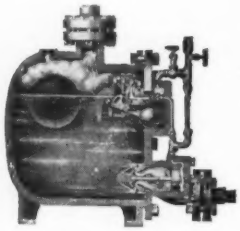
Nicholson Weight and Piston-Operated Traps Help

SOLVE CORROSION PROBLEMS

Right, Nicholson weight - operated traps for steam, air, gasoline; pressures to 200 and 650 lbs. Other models to 1500 lbs.





Above, Nicholson piston - operated steam trap, 2 to 650 lbs. pressure. Large capacity for steam purifiers, etc.

All working parts of Nicholson traps are made of stainless steels or bronze, carefully selected to give permanent resistance to corrosion. Other trouble-free features resulting in the adoption of Nicholson traps by an increasing number of large users: positive fluid seal keeps valve tight; not easily affected by dirt, pulsation, pressure variations; non wire drawing; rugged to take unavoidable abuse.

TRAPS FOR EVERY POWER APPLICATION. 5 thermostatic types for steam press. to 225 lbs.; 2 expansion types, press. to 250 lbs.

Catalog 448 or see Sweet's

W. H. NICHOLSON & CO.
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no lead steam or exhaust cushioning is present. Efficiency is lowered by clearance losses and work done in pushing exhaust out of cylinder. Best cure is to advance the eccentric.

Steam-admission line for crank end slopes towards cutoff point, while the mep is higher than the head end. From this, it appears that edge of steam valve or port is broken, dashpot is acting slowly or closing spring is weak. Another possibility that applies to all valves is that of excessive play between the valves and their operating spindles.

There is no indication of any valve leaking. Steam valve at the head end has a sharp cutoff but shows absence of lead. *AJS* should check crank-end steam valve gear and if necessary remove valve from chest. He should then advance the eccentric to give free exhaust, compression and steam lead.—**W Melville, Cheshire, England**

Adjust Valves for Proper Compression

LACK OF COMPRESSION is chief cause of pounding in *AJS's* engine. Since diagram height represents steam pressure, and card length the piston stroke, the shorter length of head-end diagram has probably been caused by faulty indicator operation.

Indicator cards show late release or opening, and late closing, as well as no compression curve. *AJS* should adjust exhaust valves to give earlier release and earlier closing until proper compression stops engine pound.

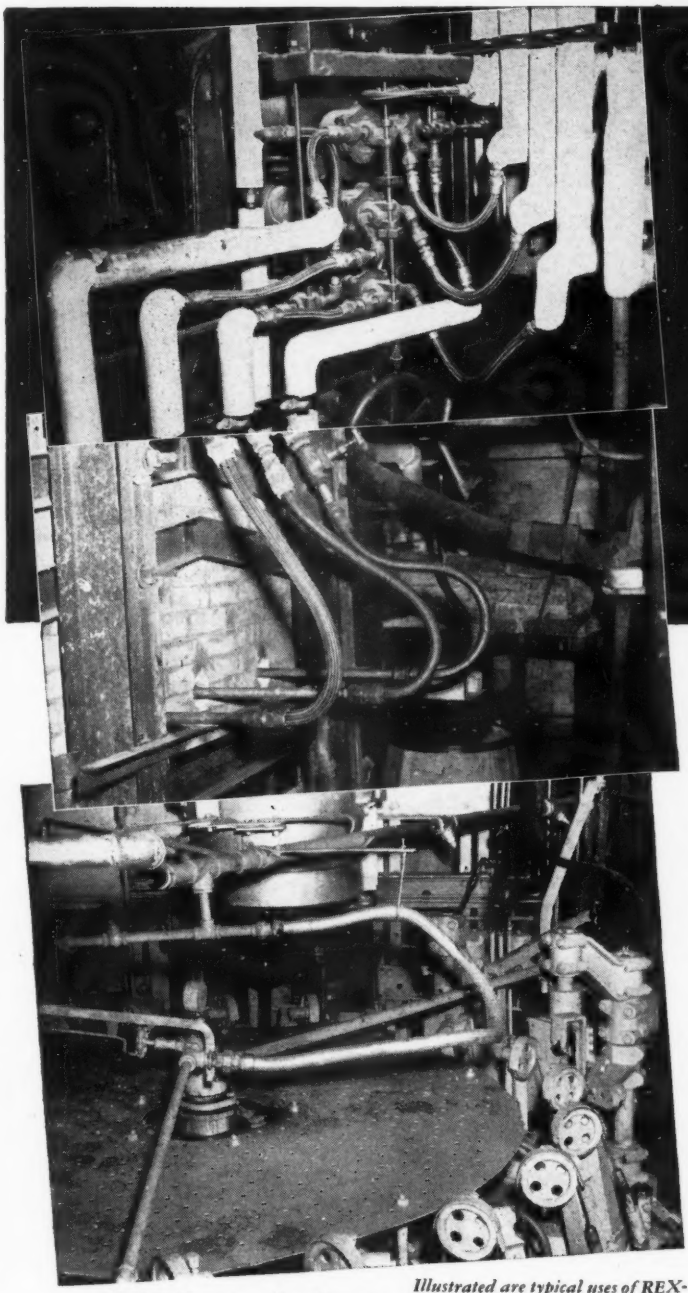
Admission is late at crank end and there appears to be a steam leak through the valve during expansion. Head-end admission appears slightly late, but it may be due to excessive clearance-volume.

Difference in mep on diagrams and slight difference in height indicates load on engine varied considerably in taking the cards from each end of cylinder. For better-proportioned diagrams he could use two indicators and take cards simultaneously. A number 40 or 50 spring should be strong enough for his slow-speed engine.—**Arthur Belton, Montreal, Canada**

Because of space limitations, we could not publish remaining acceptable answers this month. We will publish them later if possible.

Ballinger Co, architects and engineers, have moved their offices to 121 N Broad St, Philadelphia 7, Pa. They announce that they would like to receive the latest catalogs from manufacturers to bring their files up to date.

CMH REX-WELD
corrugated flexible metal hose



Illustrated are typical uses of REX-WELD. Top, *steam lines;* Center, *gas lines;* Bottom, *compressed air lines.*

the answer to leak proof conveyance of high pressure, high temperature liquids and gases

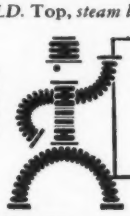
REX-WELD sets the standard for corrugated flexible metal hose. Formed from strip by advanced methods, it offers greater uniformity than is otherwise possible.

Made in both bronze and steel with helical or annular corrugations, braided or unbraided. It is particularly suited for installations where vibration is a problem or where hose is subjected to prolonged flexing or bending.

The range of applications for REX-WELD is virtually unlimited. It is capable of handling pressures to 6000 psi. and temperatures to 1000°F. Leakproof for searching liquids and gases.

Ask for data sheets and specifications, today. For corrosive services ask about REX-FLEX Stainless Steel Flexible Hose and Tubing.

"FLEXON" identifies CMH products, which have served industry for more than 45 years.



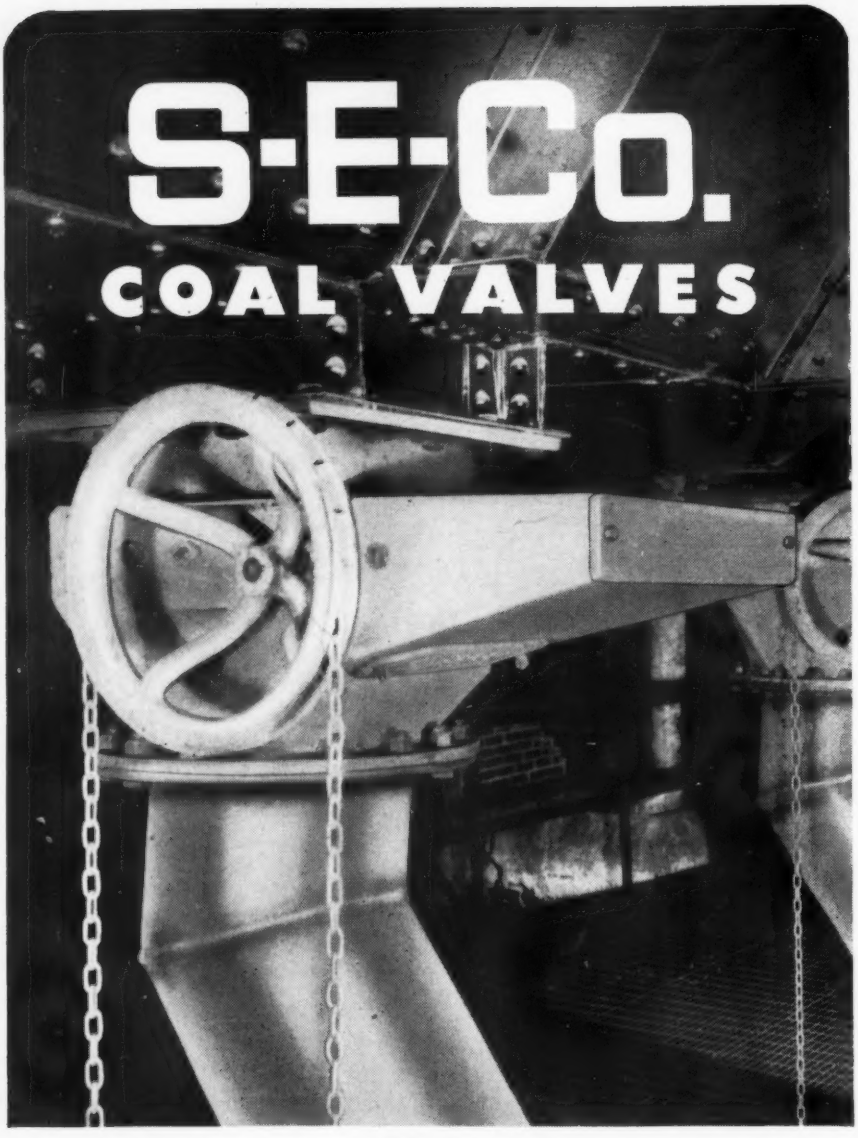
"the science of FLEXONICS . . ."the controlled bending of thin metals for use under varying conditions of temperature, pressure, vibration and corrosion"... is exemplified in the basic products of Chicago Metal Hose Corporation.

CMH FLEXIBLE METAL HOSE

CHICAGO METAL HOSE CORPORATION

Maywood, Illinois

Plants at Maywood, Elgin and Rock Falls, Illinois



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SIZES—12" to 30"
TYPES—Square or round top flanges, bolted or studs. Bottom flange—square or round collar.
OPERATION—Hand wheel, pocket sheave, offset pocket sheave, extended shaft or motorized.
POSITION—Vertical or inclined axis.
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Silica Removal

(*Continued from page 77*)

amount was relatively small. For this reason, stoppage of chemical feed to the old softeners caused immediate increase in hardness which rapidly approached that of the raw water.

EFFLUENT TURBIDITY

Turbidity of the effluent from the new softener is unusually low. The average for the three months of operation was 9 ppm. Thorough seeding of the water and filtering of the smaller particles by the larger particles of the sludge bed probably caused the low turbidity. Visual estimates made during the operation of the conventional softeners indicate that turbidities from these units were several times as high as from the sludge-blanket softener.

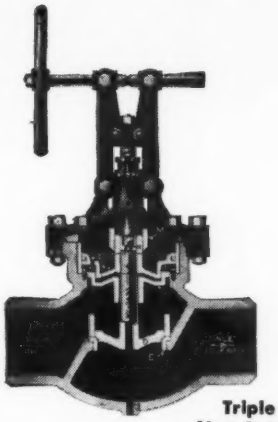
Sometimes the turbidity from a conventional-type softener is less than 10 ppm, but generally it is substantially higher; at this plant it was regularly higher than from most hot lime-soda softeners. With hot lime-soda treatment the pH of the water must be higher than 10.0 for effective softening; therefore, turbidity cannot be controlled by varying the pH as is done in the cold process where clarification is the essential problem. At this plant the pH was substantially the same with both the old and the new softeners, so that the better clarification in the new unit could be accounted for only by the filtering action of the concentrated sludge bed and by differences in size of particles formed in the two types.

Lower hardness and lower turbidity of the effluent from the sludge-blanket design softener reduces the phosphate requirements, since all of the calcium in the form of hardness and at least part of the calcium in the form of suspended particles of calcium carbonate must be reacted with by phosphate in the second stage.

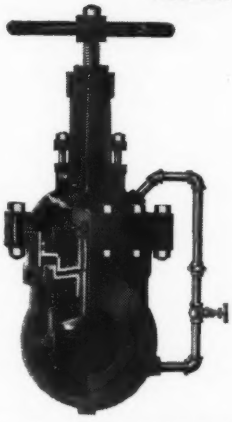
EFFECT OF FLOW CHANGES

The sludge bed was found to be equally effective for silica and turbidity removal at all rates of flow varying from 10 percent to 80 percent of capacity. In normal plant operation considerable variations in rates of condensate return and steam demand caused large changes in the amount of makeup required. These variations did not unduly affect turbidity or silica removal at any time.

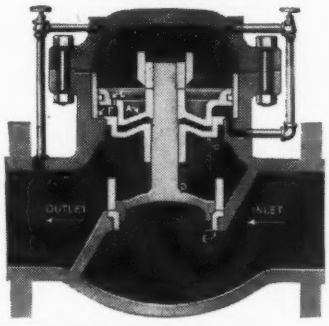
When the new softener was first operated, the sludge level was kept



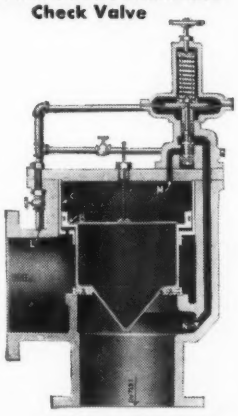
Triple Acting
Non-Return Valve



Throttle and Automatic Engine
Stop Valve



Hydraulic Double Cushioned
Check Valve



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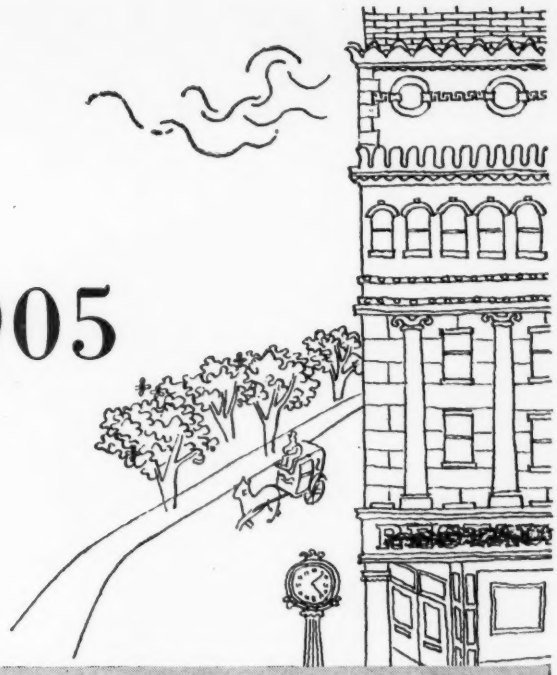

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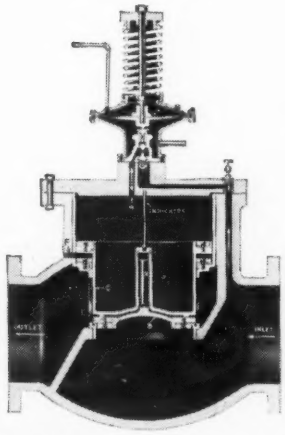

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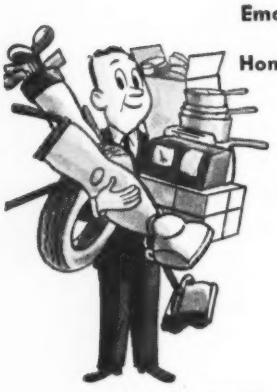

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below the top of the conical section. To see if increased silica removal could be obtained, the sludge blanket was allowed to rise into the straight section of the softener. Under these conditions high rates of flow raised the sludge only one to two feet. This indicated that the particles were sufficiently large so that, if the particles were widely enough dispersed to cause free settling conditions, they would readily settle even at maximum rates of flow. As increased flow expands the sludge layer, a condition of free settling is rapidly approached. There is no danger of carry-over unless sludge is allowed to build up to within three or four feet of the softener outlet.

BENEFITS OBTAINED

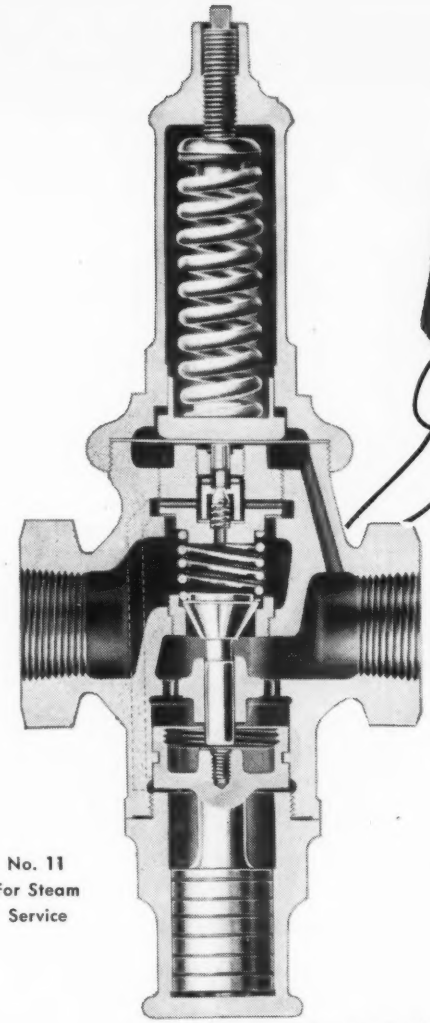
The greatest benefit obtained from the new softener is better makeup for the boilers, resulting in improved operation and reduced maintenance costs. Some of this improvement may be attributed to the use of the second-stage phosphate softener, whereas formerly phosphate was fed to the boiler drums. Much of the improvement is attributable to the new-design softener. Substantial reductions in chemical costs have resulted from the smaller quantities of magnesium oxide, phosphate. and lime required. Annual savings on chemicals alone for 1947 exceeded $6000, while the plant operated at an average of 46 percent of its rated capacity.

SUMMARY

To summarize, the following facts have been established concerning the operation of the sludge-blanket type softener as compared with the conventional type when treating raw water bearing a high silica content and medium hardness.

1. Silica removal efficiency is much greater.
2. Hardness of the effluent is lower.
3. Turbidity of the effluent is lower.
4. Uniformity of the effluent is affected much less by interruption of chemical feed or recirculation.
5. No operating difficulties are caused by the sludge layer.

An up-to-date list of all national standards approved by the American Standards Assn has been published recently. The American Standards listed have been developed through the procedure of American Standards Assn by national groups in each of the fields covered, ranging from civil engineering and construction, mechanical engineering, electrical engineering, to chemicals and textiles. Free copies of the list can be obtained from American Standards Assn, 70 E 45th St, New York 17, N. Y.



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Wide Range of adjustment without change of spring—initial pressure up to 250 lbs. reduced to any desired pressure between 5 and 75 lbs. or 75 and 225 lbs.

Full Throttling Control unaffected by varying initial pressure—accurate, fast response to demand changes.

Stainless Steel Trim at no extra cost. Hardened, ground, high polished valves and stainless steel seats prevent sticking, minimize erosion—cuts maintenance costs as much as 67%.

Sturdy Construction: Bronze bodies, screwed connections in sizes ½" to 2"; iron bodies, extra-heavy flanges in sizes 2½" to 4". Maximum working pressure 250 lbs. @ 450°F.

This reducing valve has been the "Standard" regulator for over 50 years—known the world over for its reliability, accuracy and long life.

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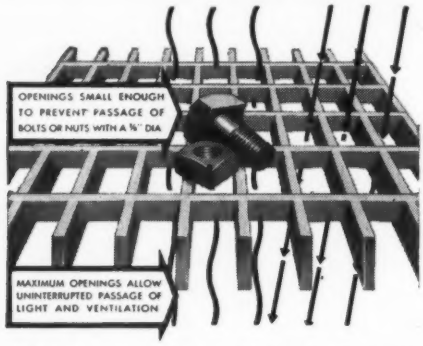
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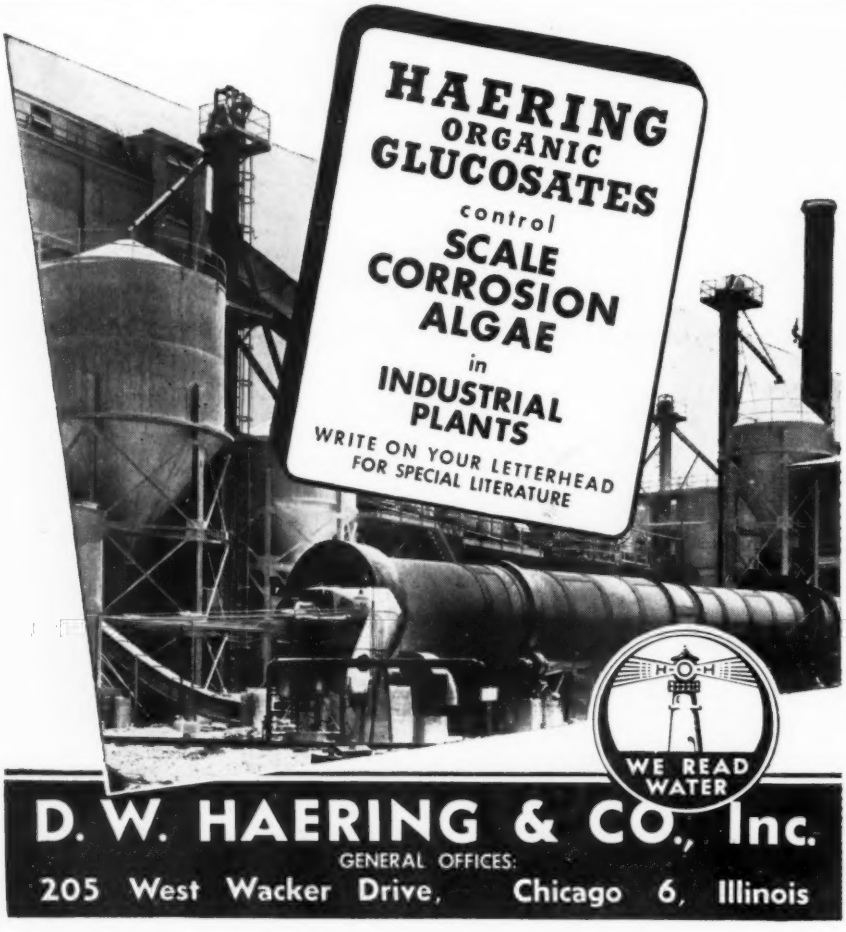

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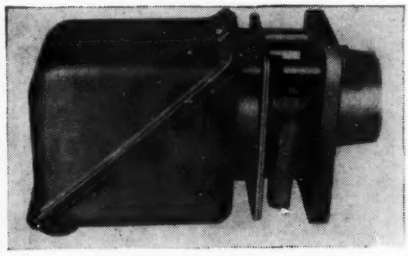
New Equipment

(*Continued from page* 122)

The clamp has a permanent buttress at lower edge of shoe with a simple, self-aligning screw jack at top edge. The brake lining, of folded and compressed metallic asbestos, is placed in the shoe and clamp tightened, which exerts a force on end of brake lining, forcing it into curvature of the shoe and holding it firmly in place. Brake lining can be removed from the brake shoe by simply releasing brake and loosening single socket screw of jack clamp. This allows sliding the lining from the shoe and inserting new lining in place. Tightening the socket head screw forces brake lining into curvature of the shoe and brake is ready for service. **Cutler-Hammer, Inc, 294 N 12th St, Milwaukee 1, Wis.**



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VALVE-CAPACITY CALCULATOR, applicable to the new K&M line of *Kontrol-Motor* diaphragm valves and pressure regulators, was developed from the results of extensive laboratory tests. It is based on: (1) rate of flow through the valve (2) static pressure and pressure drop through the valve and (3) valve size. Correction scales for steam quality and liquid and gas specific

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Install Thermolier Unit Heaters. Thermoliers are available now and there's sufficient time to do your job right.

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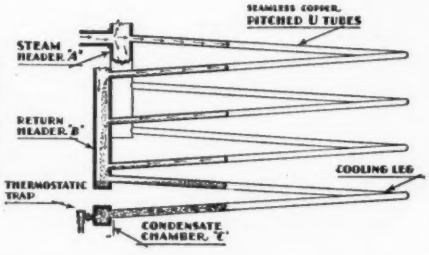

➡ Plain thermostatic trap, the simplest and least expensive kind of trap, made practical because of Thermolier's exclusive internal cooling leg.

⬆ Damaging strains caused by expansion and contraction eliminated by "U" type expansion tubes.

⬅ Maximum capacity provided at all times and annoying and destructive water hammer eliminated because built-in pitch of the tubes and internal cooling leg assure continuous drainage of condensate.

⬅ Safety and durability assured with leak-proof tube-to-header construction.

Additional desirable advantages from eight other features. Write for Thermolier Catalog 6-E.

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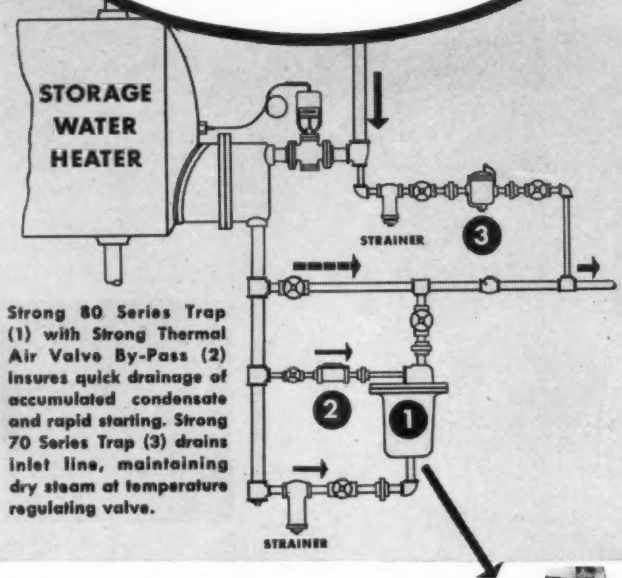
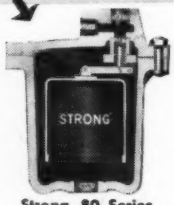


Strong 80 Series Trap (1) with Strong Thermal Air Valve By-Pass (2) insures quick drainage of accumulated condensate and rapid starting. Strong 70 Series Trap (3) drains inlet line, maintaining dry steam at temperature regulating valve.

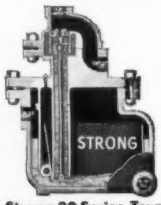
PROBLEM: Condensate accumulates in coils due to lack of pressure when thermostatic regulating valve is throttling or closed. *Improper drainage and water hammer result when thermostatic valve opens.*

SOLUTION: *Drain coils fast.* Use trap with four to eight times capacity of actual steam condensate rate. For medium or high pressures, either open or inverted bucket traps are suitable. *Use open bucket traps for low pressures.*

Completeness of the Strong trap line enables our engineers to recommend exactly the type or size you need—open or inverted bucket, closed float, float-and-thermostatic (blast), etc., forged, welded, cast or semi-steel construction. Bring your drainage problems to us for solution. Send for Strong Trap Catalog No. 67 today for complete details of *all* Strong traps.



Strong 80 Series Trap for medium or high pressures.



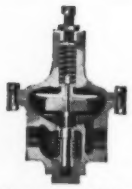
Strong 30 Series Trap for high, medium or low pressures.

STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street
Cleveland 13, Ohio

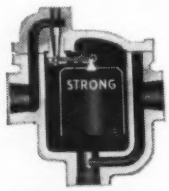
REG TRADE MARK

ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES



Reducing Valve

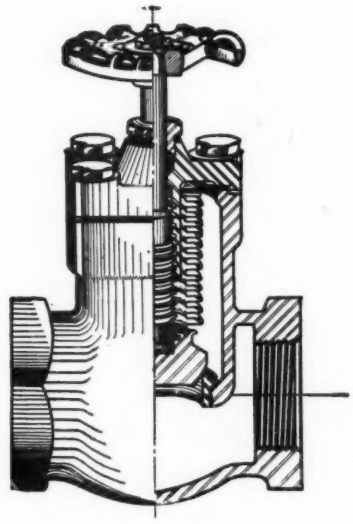


70 Series Trap

Strainer

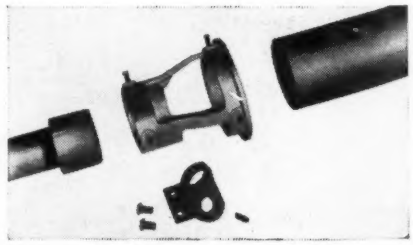
STRONG

gravity are included, as well as a flowing temperature scale for gases. Calculator is 8 in. in diameter and has long open scales that are easily read. Free with detailed instruction sheets to design, construction and process engineers and control-valve users requesting it on company letterhead. **Kieley & Mueller, Inc, North Bergen, N. J.**



Packless Valve

No. 3000 SERIES PACKLESS VALVE contains a seamless metal *Sylphon* bellows that forms a leakless connection between the valve disk and the valve body. Valve is available with stainless-steel bellows and stainless-steel body for corrosive service. Bodies are also available in bronze, cast iron, cast steel or monel. Bellows is available in either stainless steel or monel; suitable for either pressure or vacuum service. In the screwed-end type, the new valves are applicable to temperature services up to 300 F and *OS & Y* construction for temperatures up to 700 F. Special construction makes the valve suitable for temperatures up to 1200 F. Valves come in sizes ¼ up to 3 in. with screwed, welded or flanged ends. **Dept PV, Fulton Sylphon Div, Robertshaw-Fulton Controls Co, Knoxville, Tenn.**



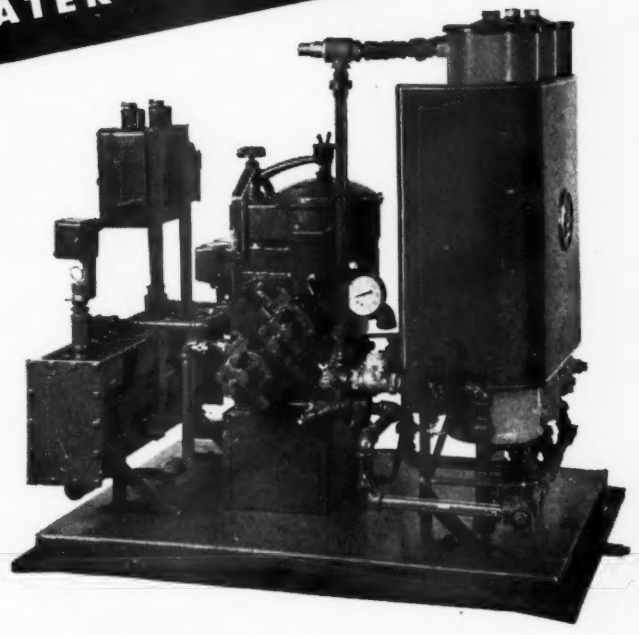
Immersion Heater

SPACER CAGES entrain required air for secondary combustion in gas-fired immersion-type heating tubes, the maker claims. Coil cages are furnished separately or in ready-for-installation assemblies complete with mixers and associated equipment.

Atmospheric coil cage has a gas cock, low-pressure injector, flame-retaining burner

3 Out!

DIRT · WATER · COLLOIDAL CARBON



THE DE LAVAL "Puri-Filter" removes ***all three*** major contaminants of Diesel lubricating oil: dirt, water and colloidal carbon. The first two are separated from the oil by centrifugal force in the bowl of the De Laval Oil Purifier — the water being discharged continuously. The colloidal carbon is filtered out of the purified oil by the Fram Filters.

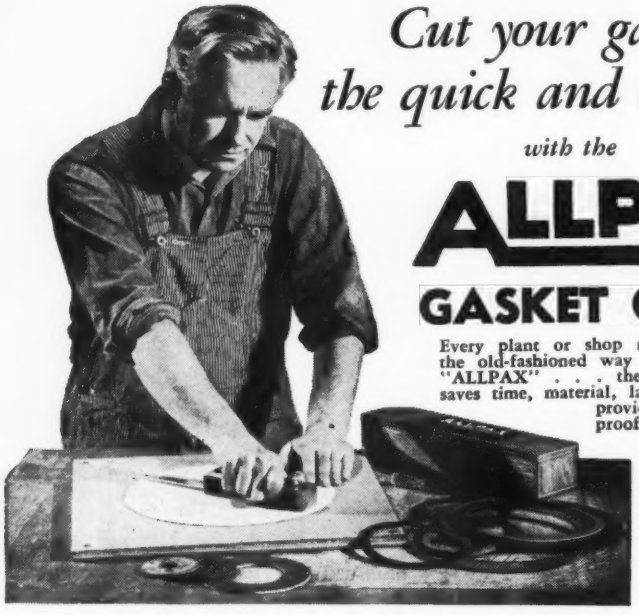
The De Laval "Puri-Filter" combines the De Laval "Uni-Matic" Oil Purifier and Fram "Filcron" Filters. Because the combination unit gets rid of all contaminants down to one micron in size, and likewise keeps the oil completely free of moisture, it is the most effective means ever devised for protecting Diesel engine bearings.

Crank cases remain clean when Diesel oil is "Puri-Filtered". Write for Bulletin DL-1, which gives additional details.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL *Oil Purifiers*

FOR DIESEL LUBRICATING OIL



Cut your gaskets the quick and easy way

with the

ALLPAX

GASKET CUTTER

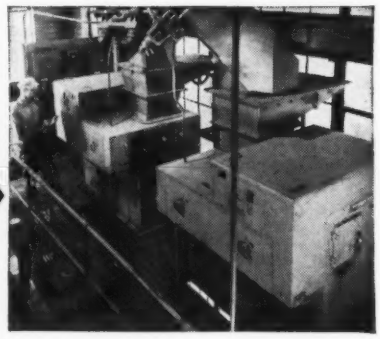
Every plant or shop now cutting gaskets the old-fashioned way by hand, needs an "ALLPAX" . . . the gasket cutter that saves time, material, labor and money. It provides a simple, foolproof method of cutting which can be done by anyone. Saves its cost in the first few gaskets cut. Cuts clean, accurate gaskets in any packing material from 1" to 36" diameter.

Furnished complete with six (6) double-edge cutting blades and one (1) 18" cutting board . . . all packed in durable hardwood case with hinged cover . . . ready for any gasket cutting job. Price $19.50 complete equipment, f.o.b. Mamaroneck, N. Y. ORDER NOW.

THE ALLPAX CO., INC.

Mamaroneck, N. Y.

STOP WASTING FUEL DOLLARS!



Typical installation of two Richardson Scales, right-hand and left-hand construction, floor-mounted with access platform between, in power plant of prominent rubber manufacturing company.

WEIGH

all coal accurately on Richardson Automatic Coal Scales

The excess dollars you may be "throwing on the fires" through inadequate coal control are avoidable—and can be eliminated with Richardson Coal Scales.

Continuous, correct readings give you an accurate means of determining the exact fuel consumption required for top boiler efficiency. This graphic information, when applied to future fuel consumption, assures you that minimum quantities of coal are burned for maximum efficiency at any rating.

Richardson complete bunker-to-boiler weighing and feeding system checks many coal dollar leaks. Scales are made in stationary, portable or elongated conveyor-scale combination; thus are adaptable to all plants, large and small, for either pulverizer or stoker-fired furnaces.

For an accurate check on boiler efficiency . . . make it by weight . . . with a Richardson Scale. Write for Bulletin No. 1143.

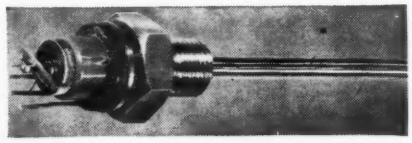
4235

RICHARDSON SCALE COMPANY, Clifton, N. J.

ATLANTA • BOSTON • BUFFALO • CHICAGO • MINNEAPOLIS • WICHITA

NEW YORK • OMAHA • PHILADELPHIA • SAN FRANCISCO • DETROIT • PITTSBURGH • MONTREAL • TORONTO

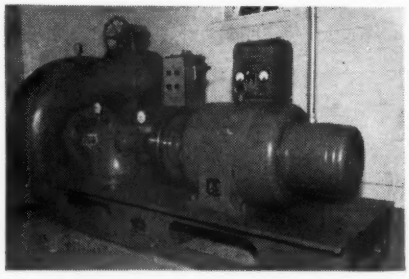
nozzle, coil cage with pilot. It uses gases with Btu contents from 450 to 3200, at pressures from 3 to 12 in. water. Pipe sizes range from 1½ to 6 in. dia. A blast coil permits higher capacities. **Industrial Div, Bryant Heater Co, 1020 London Rd, Cleveland 10, Ohio.**



Temperature Indicator

A TEMPERATURE SENSITIVE, bimetallic element, encased in a small tube, indicates slightest temperature variation through rotating a standard microtorque potentiometer. The output voltages of the potentiometer are relatively large, suitable for recording with oscillographs, galvanometer-recorders, and telemetering systems.

Designed for a temperature range from —65 to +150 C, the Type 4911 temperature transducer has an accuracy of 1% and a sensitivity of 1 C or less. Size, weight and voltage output make this instrument suitable for transmission of compartment, fuel and ambient-air temperatures. **G M Giannini & Co, 285 W Colorado St, Pasadena 1, Calif.**



Hydroelectric Unit

AC STANDARD-VOLTAGE hydroelectric generating plant is for private use on 20 to 150 ft head for 5 to 67 hp. A reaction turbine, with inward flow runner, is housed in a scroll case. Guide veins, surrounded by a ring gate, direct and control water flow to bronze runner, mounted on a special-steel-alloy shaft supported by ball bearings. Shaft housing eliminates shaft packing glands.

Turbine connects directly to generator through a flange coupling that supports the flywheel. Voltage regulator, with ammeter and voltmeter, in a self-contained case, is mounted on generator. Adjustment dials built integrally into the generator regulate turbine speed. **Northwest Machine Works, Portland, Ore.**

Welding Gloves

WELDING GLOVES style No. 804 are made of medium-weight, chrome-tanned cowhide with a one-piece leather back employing the wing-type thumb construction and fabric-lined cuff. The wing-type thumb allows maximum thumb action without binding or pulling across the palm. Sturdy

HERE is a quick-steaming unit expressly designed for maximum output in a limited space. Edge Moor design has combined a simple two-drum boiler bank, having perfect U-tube circulation, and a water-cooled furnace, integral with the boiler. Rapid response to load changes is assured by the great amount of surface exposed to radiant heat. This unit is adaptable to all fuels and is available in all sizes.

This and other types of Edge Moor boilers are available in a wide range of capacities, pressures and accessory equipment. Write for literature today. EDGE MOOR IRON WORKS, INC. Main Office and Works: Edge Moor, Delaware. Branch Offices and Agents: Atlanta, Boston, Chicago, Detroit, Hoboken, St. Paul, San Antonio and San Francisco.

● Edge Moor Vertical Flow Unit with Edge Moor superheater and air heater fired with continuous discharge spreader stoker. 40,000 lbs. steam per hour, 400 lbs. pressure, 750° F. total steam temperature.

edge moor

steam generating equipment

EM

for DRIVING COMPRESSORS...

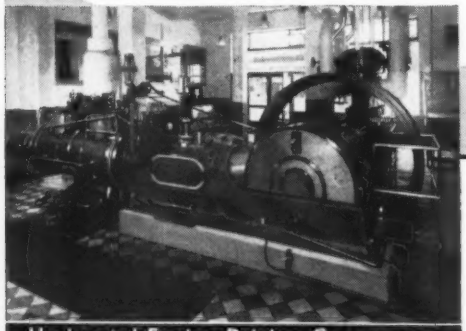
SKINNER "Universal Unaflow" STEAM ENGINES

A popular application of Skinner "Universal Unaflow" Steam Engines is for driving compressors.

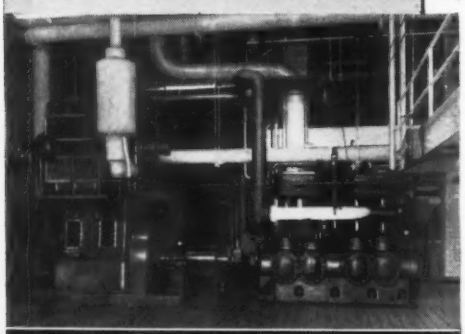
Important factors in their choice by food processors and others requiring refrigeration are their flexibility, their uniformly high economy, and their dependability, long life and low maintenance costs. Furthermore, exhaust steam is available for heating, processing and other purposes, making possible additional large savings.

Skinner "Universal Unaflow" Steam Engines are made in horizontal and multi-cylinder vertical types for ammonia, CO_2, air or hydrocarbon gas compressors; constant-speed, or variable-speed type with manual or automatic control. They are also built, in sizes from 75 to 3000 hp., for constant or variable speeds, for direct connection, coupling, belt or rope drive, to blowers, pumps, lineshafts, electric generators and other kinds of load.

Write for detailed information on the economies to be gained in your industry with a Skinner "Universal Unaflow."



Horizontal Engine Driving Compressor



Vertical Engine Driving Compressor

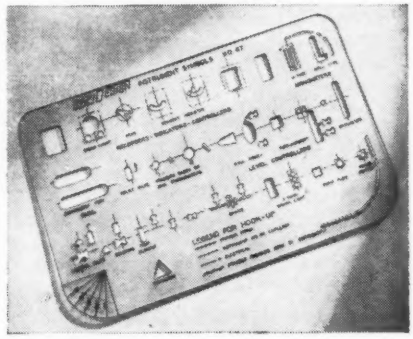
Industries using Skinner Engines for compressor drive:

- Breweries
- Ice and Cold Storage Plants
- Meat Packers
- Dairies
- Food Processors
- Hotels
- Chemical Plants

For Over 80 Years, Doing One Thing Well—Building Steam Engines

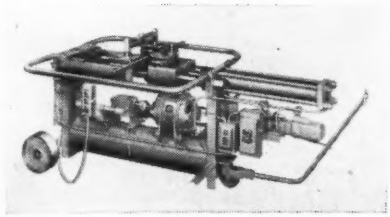
SKINNER ENGINE COMPANY, ERIE, PA.

fabric cuff lining prevents sagging or crumbling of cuff section. **Dept 1727P, Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y.**



Template

CLEAR, .040 MATHEMATICAL QUALITY plastic template is particularly adapted to layouts where liquid-level, differential pressures and flow instruments are featured. No. 47 instrument symbols template has all printing on reverse side and cutouts beveled. A 90-deg protractor plus a dotted-line radius guide are provided on the template. **Rapidesign, Inc, P O Box 592, Glendale, Calif.**



Bending Machine

No. 1402 HYDRAULIC-RAM type bending machine is a portable unit. It is equipped with standard dies for bending up to 2-in. extra-heavy-weight steel pipe. Special dies are available for angle iron, channels, reinforcing bars, flat bars, etc. Machine is suitable for construction work, radiant-heating applications, etc. A jog button provides easy control for setup or accurate duplication of special parts formed to templates. **Wallace Supplies Mfg Co, 1308 W Diversey Parkway, Chicago 14, Ill.**

Vernier Caliper

RUSTLESS CHROME VERNIER CALIPER measures from 0 to 6 in., in 1/1000 and 1/64 in. for outside, inside and depth dimensions. Tool has knife edges for measuring the root diameter of threads and points for accurate dividing. Blade and jaws are hardened throughout. The jaws have an optically

I Discovered This New Money Saving Way to Select Paints!

FREE Specification Booklet
shows how to—Select Paint for best results on each surface . . . Prevent over-ordering and underestimating needs. Lists Paint characteristics—as to acids, caustics, heat, abrasion, moisture, etc.
PRESERVING THE MATERIALS MANKIND HAS WRESTED
VALDURA
HEAVY DUTY PAINTS

It was a lucky day for me when I got the new Valdura Specification Booklet—on heavy-duty painting. I found it so practical, so easy to use, that it gave me valuable benefits when I selected the paints for renovating our plant.

As a result, we saved many dollars on the job. But best of all, we'll save many dollars every year on maintenance. This *Valdura Specification Booklet* shows the most serviceable paint to use for *every kind* of application in every industry.

Gives All the Answers—This amazing Valdura booklet lists every kind of surface that needs paint for maintenance. It shows just which kind of primers and finish coats give the best results for each surface. There's no chance of selecting the wrong paint. These recommendations are based on intensive research by Valdura's laboratories and on proved results of many thousands successful applications.

The Valdura Chart solved many other problems for me. It shows average coverage per gallon—so I knew exactly how much of each paint to order. It also shows the type and correct amount of thinner required for every paint. These were big factors in helping me save dollars on the job—and in getting the most value for the firm's money. The table showing product characteristics like moisture, abrasion, acid and caustic resistance, oil and heat was also a valuable help.

Can Save You Money—Yes, it was a lucky day for me and for my firm when I discovered the new Valdura Chart on heavy-duty painting. No wonder I say, "Send for your free copy of this amazing chart. It shows you how to save on paint jobs and cut maintenance costs. It helps you select paints that look better, last longer and improve working conditions!" Mail the coupon now!

Charts Now Ready For These 10 Industries

Bakeries
Breweries
Bottling Plants
Canning Plants
Dairies and Creameries
Institutions*
Laundries
Paper Mills
Power Plants
Sewage Disposal Plants

*Schools, Churches, Hotels, Colleges, Office Buildings—all public and private buildings.

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Valdura Division

AMERICAN-MARIETTA COMPANY

43 E. Ohio Street, Chicago 11, Illinois

"Paints that Endure"

Send for Free Copy of Money-Saving Chart Now!

Valdura Div., American-Marietta Co., 43 E. Ohio St., Chicago 11, Ill., Dept. L

Send me immediately the *free* Valdura Chart for my plant that will show me how to save real dollars—to select the correct paint, cut maintenance costs, improve working conditions.

Name and Title_____

Company_____ Industry_____

Address_____

City and Zone_____ State_____

Nothing Slips by the..

HENSZEY FLOW INDICATOR

This accurate instrument goes into action as soon as the first fluid starts to pass through. It registers any rate of flow from zero to 100 per cent — instantly and accurately — as it occurs.

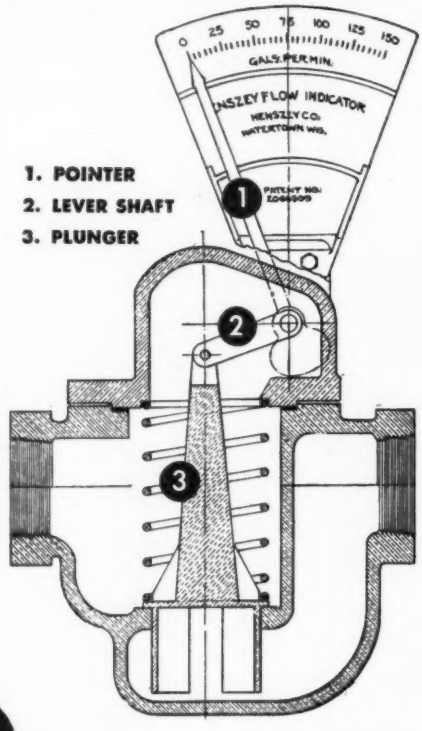
If your manufacturing process demands an accurate check on the rate of flow of liquids such as boiler feed water, condensate, gasoline, light oils, free-running chemicals etc. — plan now to investigate the Henszey Flow Indicator.

Send for special bulletin FI-1.

HENSZEY COMPANY, Dept. D-7, Watertown, Wis.

There are only three moving parts in the Henszey Flow Indicator—the Pointer, the Lever Shaft and the Plunger. And that means longer wear, continued service, and constant accuracy.

The liquid enters the indicator below the plunger, forcing the plunger upward. Slots in the side of the plunger allow the liquid to pass. Increased flow will increase the lift, exposing a greater area of the slots, so that the lift of the plunger is in direct proportion to the rate of flow of the liquid. The graduations on the dial are uniformly spaced from one end to another and read direct — without constants. The entire instrument can be installed right in the pipe line.

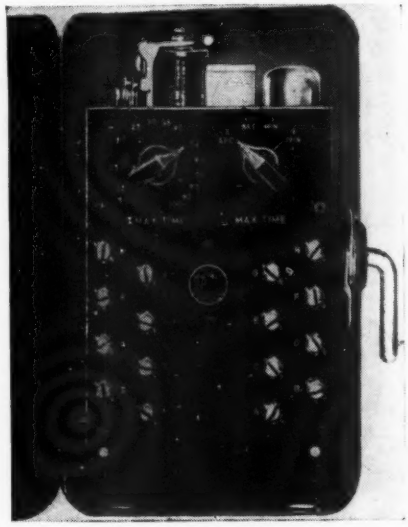


HENSZEY

FLOW INDICATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Boiler Feed Regulators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

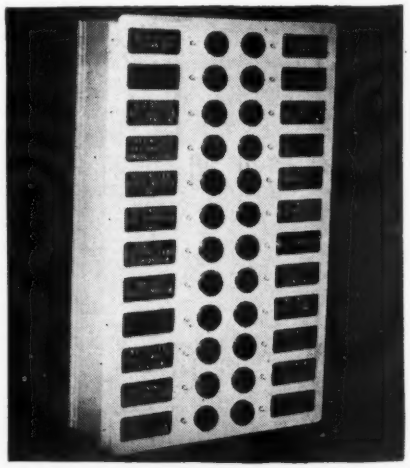
lapped finish, and when checked with optical flats show the measuring surfaces are accurate to 8-millionths of an inch, says the manufacturer. **George Scherr Co, 200 Lafayette St, New York 12, N. Y.**



Electronic Interval Timer

SERIES 30 TIMER is designed for machinery and process control. The nominal range is from .03 sec to 4 min. It provides for all basic types of timing through simple terminal panel connections.

The timer can be supplied for 115-230 v, 50-60 cycles, having a contact rating of 10 amp at 115 v ac. It is recommended for control of hydraulic compressors, chemical feeders, spot welders and similar equipment. **Photoswitch, Inc, 77 Broadway, Cambridge 42, Mass.**



Portable-Visual Annunciator

SPECIFICALLY DESIGNED for power generation and distribution plants, the Type *ANF* annunciator can be used as well in industrial applications. Each annunciator is made up of individual units consisting of a main lamp to provide illumination of the translucent markings and enclosed pilot light and a control relay.

Each unit is jack-connected to the circuit, and is mounted on a metal slide to facilitate removal for service or replace-

How to INCREASE BOILER RATINGS with your present furnace and stack

Coppus-Dennis FANMIX Burners Give You More Heat with No Other Major Change in Equipment

Coppus-Dennis **FANMIX** Burners give you *perfect* mechanical mixing of fuel and air *at the burner outlet . . . instantaneous* ignition close to the burner . . . and *complete* combustion *without visible flame* when burning natural gas. No other burner combines these three advantages.

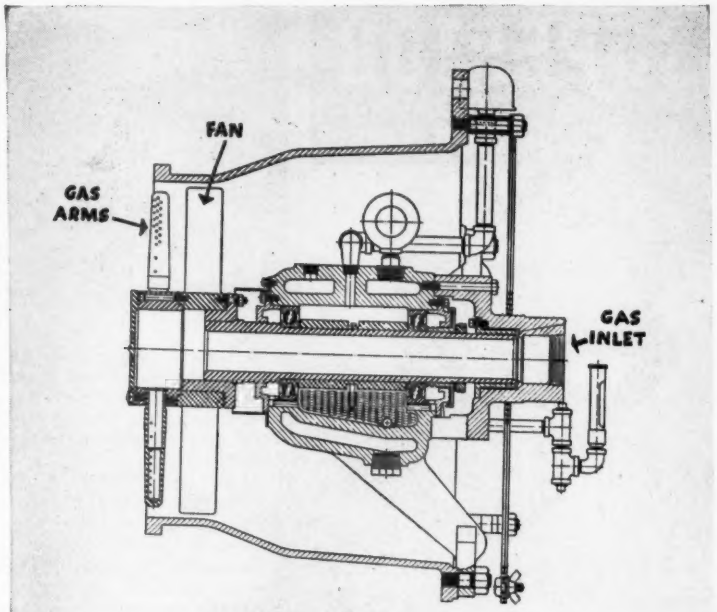
Because **FANMIX** delivers the *right* mixture of fuel and air *without blow-torch action*, all of your furnace space is used for combustion . . . *none for mixing*. That's why your present furnace can release more heat . . . why new installations can get more heat out of smaller furnace space.

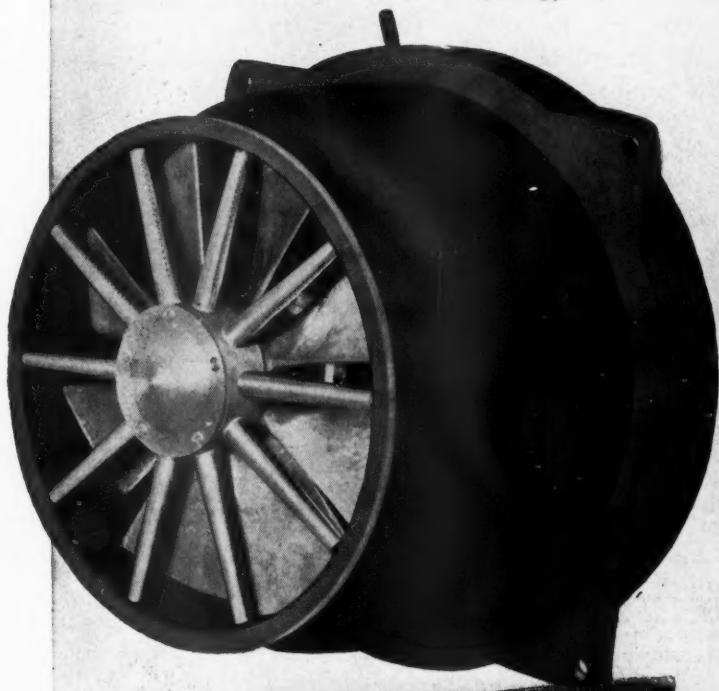
Because **FANMIX** can be guaranteed to secure complete combustion of natural gas *with less than 5% excess air*, you get uniform "radiant heat" *without drifting hot spots*. That's why a FANMIX-fired furnace seldom varies in temperature more than 5% over its entire area.

WRITE FOR ALL THE FACTS

When you see in Bulletin 410–5 how fuel escaping from orifices in rotating driver arms rotates the fan to draw the correct proportion of air into the path of the fuel at right angles . . . how **FANMIX** creates its own forced draft, reduces stack requirements, prevents cracking of "wet" gas . . . how two FANMIX types handle either gas or oil or any combination of both — you'll understand why **FANMIX** Burners have such wide acceptance in oil refineries and power plants.

Send for the Coppus-Dennis **FANMIX** Bulletin 410–5. Coppus Engineering Corporation, Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, and REFINERY CATALOG.





ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

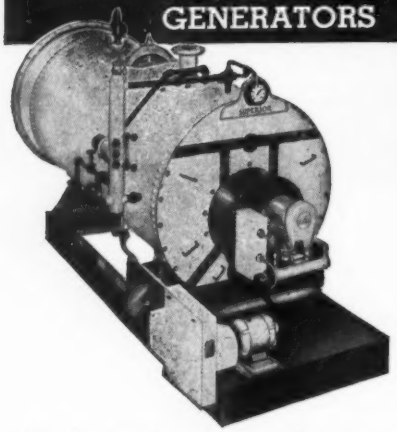
COPPUS ENGINEERING CORP.
167 Park Ave., Worcester 2, Mass.
Please send Bulletin 410–5 to:

Name .....

Company .....

Address .....

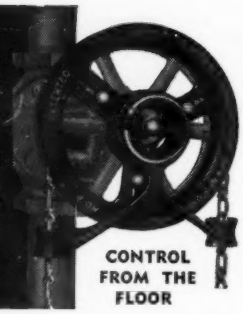
SUPERIOR
STEAM GENERATORS



Fully automatic with any grade of oil. 17 sizes from 20 to 500 b.h.p. for pressures up to 200 p.s.i. Require no expensive chimney, supply their own induced draft. 80% thermal efficiency guaranteed. Write today for catalog 101.

Superior Combustion Industries, Inc.
Factory: Emmaus, Pa.
Executive Offices: Times Bldg., Times Sq., N. Y.

Makes ALL VALVES *INSTANTLY* Accessible



CONTROL FROM THE FLOOR

● Instant, handy, safe control of overhead and other out-of-reach valves. Eliminate danger to employees; banish the stepladder. Now — install valves anywhere they should be, regardless of accessibility.

Inexpensive BABBITT Sprocket Rims fit all types and makes of valves, with either rising or non-rising stems. Installed quickly by clamping directly onto hand wheel of valve. Eliminates makeshift apparatus and specially-made chain wheels.

● Ten standard sizes take care of all valve wheels from 2 to 30 inches in diameter.

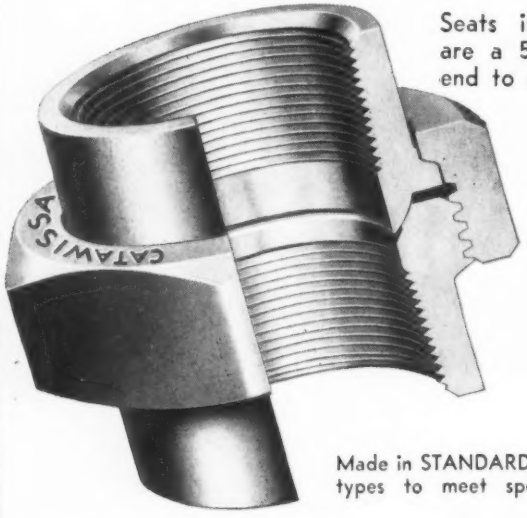
● *Request Catalog Bulletin P, prices, name of local distributor:*

Babbitt Adjustable SPROCKET RIM with Chain Guide

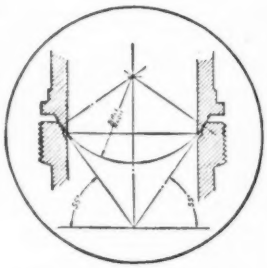
BABBITT STEAM SPECIALTY COMPANY
Manufacturers of Adjustable Valve Operating Mechanisms
New Bedford, Mass., U. S. A.

CATAWISSA UNIONS give you a PERFECT SEAL
even when the pipe is not in perfect alignment!

● HOT FORGED STEEL
● STAINLESS STEEL



Seats in all Catawissa Unions are a 55° angle on the female end to a BALL on the male end —assuring good, tight, leakproof joints!



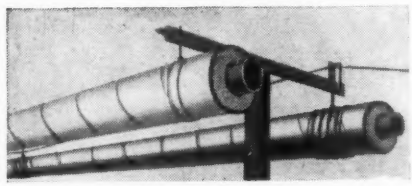
Made in STANDARD and DOUBLE EXTRA HEAVY types to meet specific pressure requirements!

Double Extra Heavy
Hot Forged Steel
SWING CHECK VALVES

write for your copy of BULLETIN 10-A

CATAWISSA VALVE & FITTINGS CO.
206 Mill St. • CATAWISSA, PA.

ment. The annunciator is available for either ac or dc operations, at voltages depending upon requirements. **Autocall Co, Shelby, Ohio.**



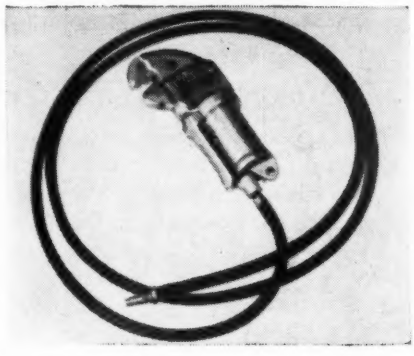
Insulated Piping

PREFABRICATED, factory-insulated 21-ft lengths of pipe can be supplied with asbestos, cork or any other insulation specified. Manufacturer machine-coats insulation with high-temperature asphalt, and tension wraps it with asphalt-saturated asbestos felt. A second coat of asphalt follows, plus a tension wrapping of aluminum or copper foil to give a good bond with the asphalt.

In addition to the basic *Foilclad* unit, there is a variation which has a pipe within a pipe. The outer pipe is insulated to allow carrying a desired temperature within the pipes. For process service, either pipe can carry the process fluid while the other carries a heating or cooling medium. **Dept 9582B, Ric-wiL Co, Cleveland, Ohio.**

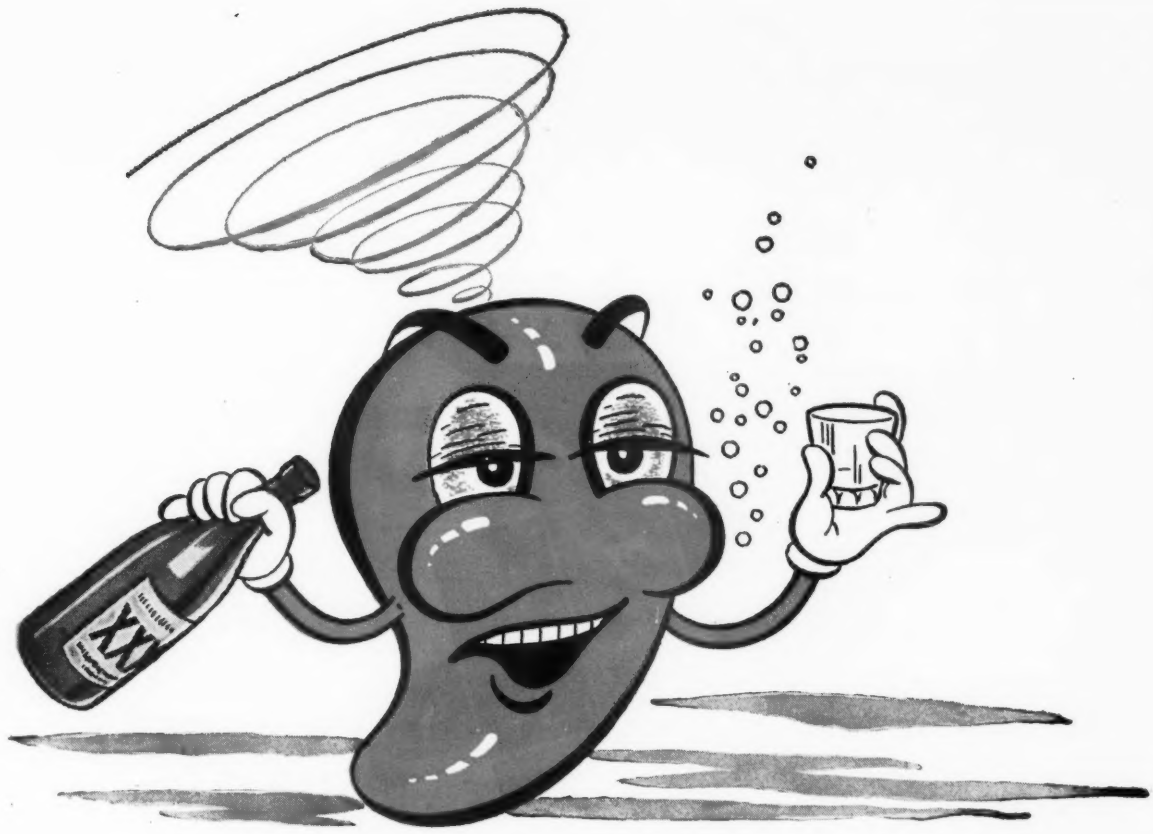
Tinner's Fire Pot

LOW-PRESSURE, smokeless, sparkless, sootless tinner's fire pot, No. 475, carries a flame and carburetor control for burning the one-gallon fuel capacity. Burner coil, protected by an outer jacket, is of extra heavy, seamless steel tubing. An automatically controlled orifice cleaner plus quick accessibility for cleaning are also featured. **Turner Brass Works, Sycamore, Ill.**



Compressing Tool

POLYPRESS Y8NA PNEUMATIC HYPRESS for indenting smaller sizes of *Hylugs* and *Hylinks* is for use where ordinary power tools cannot be conveniently operated. *Polypress* delivers about 2000 lb indenting force from an air pressure of 80 to 100 psi. Lower pressure can be used for the smaller size connectors. Removable dies accommodating conductors from No. 8 to No. 22 *AWG* are set in compact jaws that allow ample clearance for correctly locating connector and cable assembly for indenting. **Burndy Engrg Co, 107 Bruckner Blvd, New York 54, N. Y.**



dissipated is right!

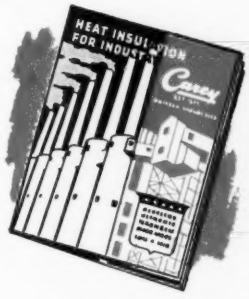
The staggering cost of BTU'S dissipated in your plant every day, every night, is a real headache if you're trying to cut costs. (And who isn't!) Waste occurs whenever and wherever inefficient insulation—or *no* insulation—gives heat energy an excuse to "pass out". Industry picks up the check for these escapades—and it isn't hay!

CAREY'S THE DOCTOR . . . on call, 24 hours a day, with COMPLETE INSULATION SERVICE to help diagnose causes of chronic heat dissipation in your plant . . . to administer a sure cure. **CAREY** offers complete industrial insulation engineering facilities, built up by over 75 years of serving industry. Those facilities are doubly valuable because they are backed up by:

1. engineering know-how gained from countless actual experiences on industrial insulation jobs of all sizes and shapes.
2. a complete line of industrial insulation materials

ROCK WOOL—MAGNESIA—ASBESTOS

3. materials strategically warehoused from coast to coast.



ALL OF THIS IS AVAILABLE to help you in *any* way . . . from an insulation survey to a complete installation. Take advantage of it! Meanwhile you'll want to . . .

Write for your free copy of "Heat Insulation For Industry." This helpful booklet is an excellent guide to selection of industrial insulation—contains specifications and tables you'll want to keep handy. For your *free* copy address your request to Dept. PO-7.

Carey 75 *years serving home and industry*

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Pipe Coverings • Sheets • Blocks
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The company your boiler keeps . . .

APEXIORIZED

New boilers APEXIORized during the past year alone are serving these industries:

CHEMICALS	MACHINERY
FOODS	PUBLISHING
PETROLEUM	UTILITIES
BREWERIES	GOVERNMENT
TEXTILES	INSTITUTIONS
PAPER	MINING

Pick any industry where steam is generated for power or process and you've named a representative group of APEXIOR users — engineers who have proved the worth, in boilers large and small, of internal protective surfacing.

They know that even the strongest steel is powerless to resist moisture penetration — that water at its finest retains the capacity to impair — can never improve — bare steel. And so they separate the two, sealing boiler metal beneath a tissue-thin barrier of APEXIOR NUMBER 1.

Meeting steam and water is a surface that neither can dissolve — smooth, to deny a foothold to deposits — inert, so that it forms only a readily broken mechanical bond with any that adhere. The result, for the legion of APEXIOR users — —

- *maximum boiler availability — security against corrosion*
- *improved circulation, through friction-free tubes*
- *constant high heat-transfer efficiency*
- *easier, less frequent cleaning — lower maintenance cost*
- *speedier, positive inspection*
- *less outage time — longer on-the-line service*

Write us for more facts about:

DAMPNEY maintenance for metal

THE DAMPNEY COMPANY of AMERICA • Hyde Park, Boston 36, Mass.

Power News

(*Continued from page* 138)

of these pages has resulted in many improvements in style and presentation, in recognition of which she has been promoted to Assistant Editor.

Tucker Made Standards Manager for ASME

Standards Dept of American Society of Mechanical Engineers, which handles programs of ASME Boiler Construction Code, Power Test Codes, Safety Codes, and development of Dimensional Standards under procedure of American Standards Assn, will be headed by S A Tucker, formerly managing editor of *Electrical World*, a McGraw-Hill publication.

Tucker brings to ASME more than ten years of editorial experience on the staffs of POWER, *McGraw-Hill World News*, and *Electrical World*. His earlier activities included power plant design and construction for the Hudson Ave Station of Brooklyn Edison Co.

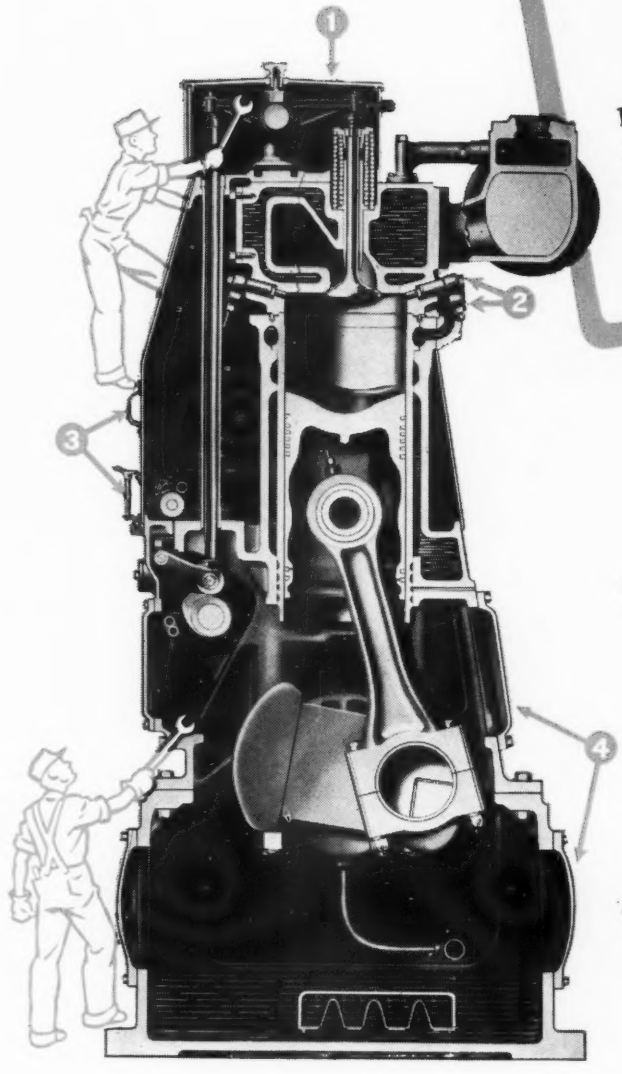
Production of electric-generating equipment will probably provide the major problem in meeting national power requirements in event of another emergency. That is a preliminary conclusion reached by government and utility industry experts who have been conferring recently with National Security Resources Board in Washington, D. C. What to do about supply of heavy power equipment, however, is something else again, the specialists are convinced.

Preliminary reports of two advisory committees were received recently by Edward Falck, NSRB's chief consultant on utilities. The findings of these groups will be consolidated by Falck into a formal report to Chairman Arthur M. Hill. Though NSRB aides refused to comment on the work of the utilities section to date, it was learned that its major concern was for the ability of manufacturers to produce equipment necessary to maintain electric utility operations on a wartime basis.

Aluminum Co of America announces plans for erection of an aluminum-producing plant at Point Comfort, near Port Lavaca, Tex. The new plant will use natural gas for generation of large amounts of electric power required for aluminum production. The plant site is on Matagorda Bay, in the area between Houston and Corpus Christi, and comprises over 3000 acres of land bought from Bauer & Smith contractors. Electric-generating equipment to be installed at the Alcoa project will have an 80,000-kw installed capacity. Operation of this power plant using natural gas will mark the first peacetime use by Alcoa of electricity generation by other means than waterpower to produce aluminum, except for a brief space in the earliest days of the industry.

It's easy to service an I-R Diesel . . .

Look at the cross section of this Ingersoll-Rand Diesel and you'll see why. It is designed to give your operator quick and easy access to every working part. The engine is only 7 feet high, so there is no need for ladders or platforms. The engine parts are small enough so that all usual inspection and repair work can be handled by a ½ ton hoist.



1. **Easily removable, individual valve covers provide quick access to the valve mechanism.**

2. **Individual spray nozzles can be removed by taking off two nuts. The fuel pipe connection is easily detachable.**

3. **Quick-opening latches hold these dust tight covers in place. This makes it easy to get to the fuel pumps, injection nozzles, fuel oil manifold and fuel pump control shaft.**

4. **Extra large crankcase doors provide easy access to the lubricating oil header and bearings.**

This accessibility in Ingersoll-Rand Diesels is important. It makes an easy job of routine servicing and inspection. It saves time during periodic engine inspections. For complete information on I-R Diesel engines, call an Ingersoll-Rand Branch office. Engine sizes range from 225 to 900 hp for 6 to 8 cylinder engines.

IR

AIR TOOLS • COMPRESSORS • ROCK DRILLS
CENTRIFUGAL PUMPS • TURBO BLOWERS
OIL AND GAS ENGINES • CONDENSERS

Ingersoll-Rand

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164-7

90% OPEN AREA

for light and ventilation

THE illustration shows the admission of light through three floors where the flooring is Hendrick Mitco.

Not only does pressure-formed Hendrick Mitco Open Steel Flooring have 90% open area, but there are no bolts, rivets or angle irons to collect dirt and refuse. The square-edge, uniformly spaced, rectangular steel bars provide a non-slipping, level walking surface. There is no lateral deflection, however heavy the loading, because each Mitco panel is a strong, integral unit.

SEE OUR CATALOG IN SWEET'S

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Manufacturing Company

Perforated Metals
Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring,
"Shur-Site" Treads and
Armorgrids

46 DUNDAFF STREET, CARBONDALE, PENNA.

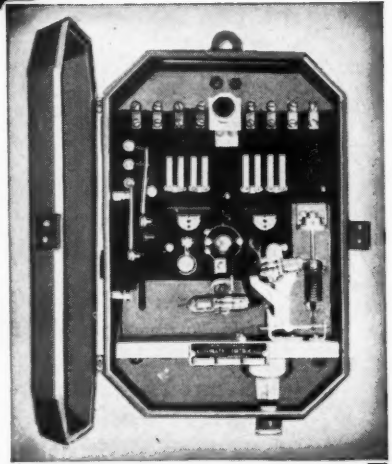
Sales Offices In Principal Cities

Prevent DRY PUMP OPERATION

with the New

AUTOMATIC CONTROL CO.

PROTECTROL



If your primary control calls for pump operation, and water is not discharged —PROTECTROL stops the pump, locks out the starter until PROTECTROL is manually reset. It also rings alarm bell and lights warning signal. It prevents damage to bearings and excessive wear caused by running the pump dry. PROTECTROL can be used with any make of pump or automatic control. PROTECTROL is better than an insurance policy—it prevents damage before it occurs. Write for Bulletin T-1130. State your requirements and engineering data will be furnished.

"AUTOMATIC" also makes pressure and float operated pump controls: multi-circuit sequence type, multi-circuit program type, float switches, automatic alternators, and many special controls built to specifications.

AUTOMATIC CONTROL Company

1009 University Ave., St. Paul 4, Minn.

AUTOMATIC CONTROLS are used by all leading pump manufacturers. When ordering new pumps, specify controls by AUTOMATIC CONTROL CO.

Charles B Hill (left) vice-president, and Ernest H Peabody, president, of Peabody Engineering Corp, returned in June from a trip to Europe. Photo shows Hill and Peabody as they left for Europe on S S Queen Mary in April. The purpose of their trip was to analyze foreign markets and war-born engineering developments in combustion and power fields

Congress will turn thumbs down on the Tennessee Valley Authority's proposal to build a $54,000,000 steam-generating plant at New Johnsonville, Tenn. TVA will not get a flat "no" on the project, however. Congressional action will take the form of refusal to approve an item of $4,000,000 in the agency's annual budget to start construction of the plant. TVA will be advised—perhaps invited—to discuss the proposal with Congressional groups later. But possibility of starting construction of the plant this year will definitely be foreclosed.

Los Angeles Dept of Water and Power took preliminary steps recently toward construction of six hydroelectric power plants on Kings River in the high Sierras east of Fresno, Calif. The six plants, with a total capacity of 250,000 kw, would increase the department's total power production by almost a third. Cost of building the plants and 280 miles of transmission lines, together with six necessary dams, was estimated at $100,000,000.

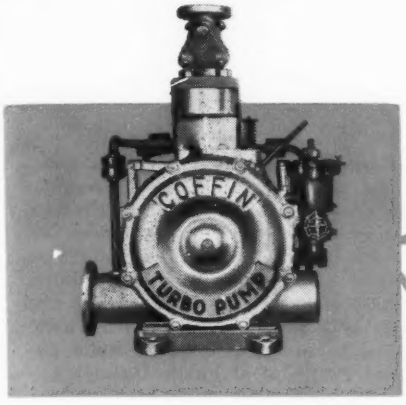
Samuel B Morris, general manager of the dept, emphasized that the project will not take one drop of water out of the area. Instead, it will conserve water now lost in periods of heavy runoff and be of great benefit to irrigation in San Joaquin Valley. Morris applied to Federal Power Commission and State Div of Water Resources for reinstatement of Los Angeles' hydroelectric power claims on the river. The dept originally applied for power claims in the area in 1926, and since that time has spent about $100,000 on preliminary surveys and engineering.

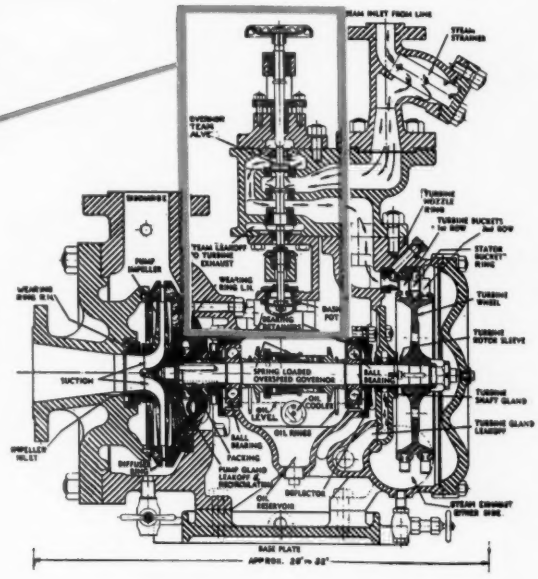
Present plans call for construction to begin in 1951.

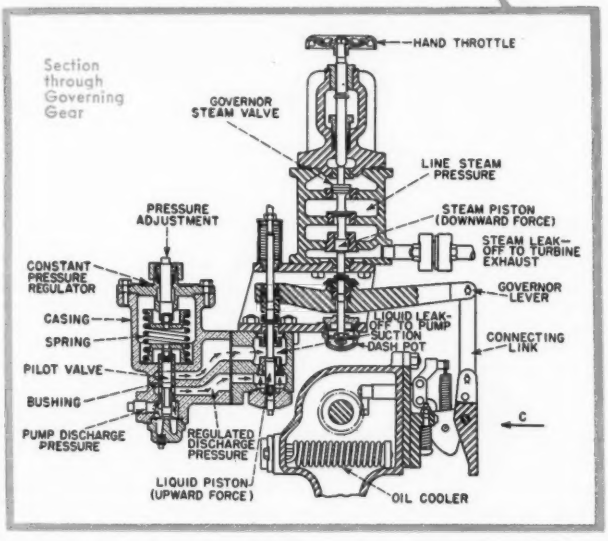
Assets of the 100-year-old Skinner Engine Co, Erie, Pa., have been acquired by Cincinnati Time Recorder Co. Out to maintain its established reputation as producer of steam engines for generating plants and also for marine operations, Skinner Engine will soon have a part of its plant converted for production of aircraft parts. Skinner will be operated as a division or subsidiary of Cincinnati Time Recorder with Joseph J Schott as acting director, succeeding J L Skinner, former president. A corporation will be formed to own the Skinner Engine Co name.

COFFIN TURBO PUMPS

HIGH SPEED • SINGLE STAGE







7- MATCHED Pump, Turbine and Governors . . . under ONE RESPONSIBILITY

The advantages of coordinated design and centralization of responsibility do not require elaboration.

Standardized Boiler Feed Units for:

Steam Pressures to 650 PSI
Steam Temperatures to 850 F
Back Pressures to 60 PSI

Pump Capacities to 500 GPM
Discharge Pressures to 750 PSI (Heads to 1800 feet)
Liquid Temperatures to 300 F

UNIQUE FEATURES

1. Standardized Steam Turbine Centrifugal Pump and Governor Sets, individually engineered, assembled, and tested . . . for IMMEDIATE SHIPMENT.
2. No destructive casing erosion-corrosion.
3. No interstage leakage.
4. Wide range exact pressure governing.
5. Loss of suction reduces speed without tripping; automatic speed recovery with suction restoration.
6. High efficiency pump plus high speed two-bucket row turbine result in minimum steam consumption.
7. Matched Pump, Turbine and Governors under one responsibility.
8. Exact hydraulic and mechanical balance—light weight rotor—large bearings; result: bearing troubles practically unknown.
9. Pump Gland Leakoff provides adequate recirculation; suction pressure only on packing.
10. Rigid one-piece steel casing plus heavy shaft plus ample clearances result in no damage from dry operation.
11. All parts made to gage and replaceable without fitting; all parts in stock at factory with wearing parts available from agencies' stocks.
12. Proved for performance over a period of more than twenty years in service.
13. Compact, light in weight, quiet and low in maintenance.

Literature sent on request; specific proposals on receipt of operating date.

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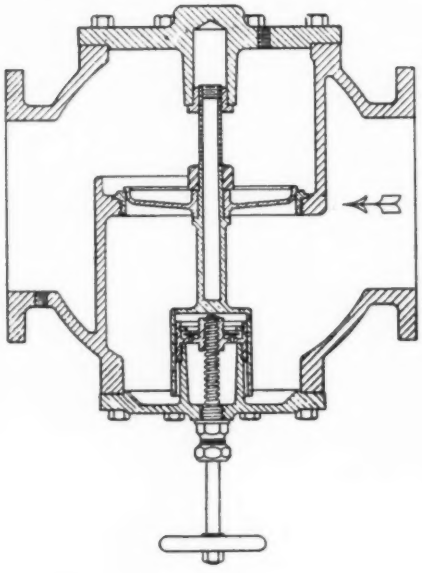
CONDENSER RELIEF VALVES



A DAVIS Specialty!

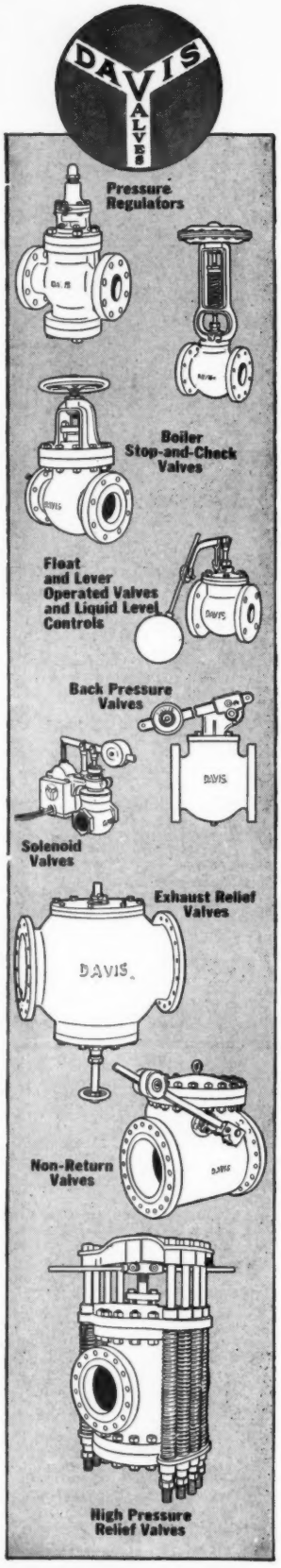
DAVIS specializes in building atmospheric exhaust relief valves to meet the modern needs of power plants for protective equipment. The Davis No. 110 Relief Valve, shown in cross-section above, is one of the several widely-used Davis designs that give engineers what they want for condenser protection.

No. 110 features a quick opening and cushioned closing action. The bronze-to-bronze-contact valve is water-sealed through inlet and overflow pipe connections in the body. It holds tight under high vacuum to prevent air infiltration into the condsener and relieves to atmosphere at a fraction of a pound pressure when for any reason the vacuum is lost. Shown here with hand lift at bottom, it is also available with hydraulic lift.

The Davis line of exhaust relief valves is complete. Sizes from 6" to 48". Horizontal, vertical, or angle body patterns. For detailed information, ask for Bulletin No. 101A.

No. 110 Exhaust Relief Valve

Left. — Davis has brought the atmospheric relief valve to a high point of perfection, with a combination of engineering features not found elsewhere.



DAVIS REGULATOR CO.

Representatives in All Principal Cities

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America's most powerful aircraft jet engine now in production, General Electric's torpedo-shaped *TG*-190, which is capable of producing about 10,000 hp at the top speed of the new planes being built for its application, has been announced by U. S. Air Force and the company's aircraft gas-turbine divisions. Known as the Air Force *J-47A*, the new engine is a "greatly advanced" development of the company's axial-flow *TG*-180 (*J*-35) jet engine which is the power plant of ten different types of military jet-propelled fighters and bombers.

Building program at the Municipal power station in Jamestown, N. Y., in connection with the $4,000,000 expansion of electrical production is expected to get under way this fall, according to Clayton O Johnson, superintendent of Dept of Public Utilities. Johnson said that there is no detailed plan available yet, although plans of the building to house the new power units purchased by Board of Public Utilities have been made.

Brown Instrument Co, Philadelphia, announces a $2,500,000 expansion program that will add more than 60% to its present manufacturing space and a proportionate increase in employment. The program includes construction of a 4-story addition to the main plant at Wayne Junction. Building began in May and first phase of the project is scheduled for completion next March. Foundation and footings of the new wing are designed so that four additional floors may be added at a later date.

American Standard Practices for Stationary Diesel Engines is a new book that has been adapted for those who buy, use or specify stationary diesel engines, of American make, in Spanish speaking countries. The new book is a translation of the text published two years ago by Diesel Engine Manufacturers Assn of Chicago, for use in the U. S. Before having the 1946 edition translated into the Spanish language, the association revised it to bring it up to date and to make it suitable for use in Latin American countries. Chief among such revisions are dropping of the tolerance in fuel consumption guarantees and conversion of weights and measures to metric system.

Two revisions in the book, *Standard Practices for Stationary Diesel Engines,* have been announced by Diesel Engine Manufacturers Assn. Formal notice of these revisions is being given through a printed page, which may be inserted in the chapter titled, "Standard Performances and Equipment." One change is addition of a new curve giving altitude ratings for turbocharged diesel engines. Altitude above sea level is given in meters as well as feet, to make the curve adaptable to the new Spanish edition. Second revision is omission of fuel tolerance of 3%. The association states that the fuel tolerance is also being omitted from its new book, *Marine Diesel Standard Practices,* which has just come off the press. "All this means," the new insert page states, "that few, if any, engine builders will include a tolerance for fuel in the future."

"FUNNEL TOP" DESIGN STREAMLINES AIR FLOW
Advantages of the C. H. Wheeler "Funnel Top" over the conventional flat top design of cooling towers, are obvious, i.e., smoother air flow, no dead areas, fewer eddy currents, air circulation direct thru water cooling zone to fans, increased efficiency, etc. This modern, streamlined design is only one of the many reasons why C. H. Wheeler Induced Draft Water Cooling Towers are preferred for numerous installations throughout the United States and in foreign countries. Write for Catalog No. 145 today.
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REPRESENTATIVES IN MOST PRINCIPAL CITIES
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STEAM CONDENSERS • WATER COOLING TOWERS
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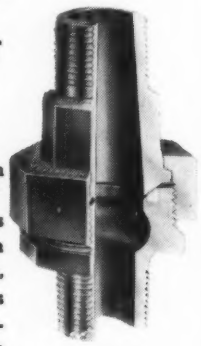
JEFFERSON UNIONS

feature the **RECESSED BRASS SEAT facilitating piping jobs**



Jefferson All-Male Union

The Jefferson Union line includes 90° and 45° Elbows and Union Tees in a variety of types, the Recessed Brass Seat being an exclusive feature in all types.

The Recessed Brass Ring seating provides a straight through, unobstructed, metal-to-metal, spherical ground joint protected from ends of pipe in the event that they are screwed in too far.

Get in touch with your nearest distributor or with us direct for further details.

JEFFERSON UNION CO.,

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New Films

Lincoln Electric Co has recently released a new movie, *Designing Machinery for Arc Welding*, to assist designer and engineer to use arc-welded steel in design of all types of machinery in many hundreds of different industries. This new 16-mm sound color movie, which has a running time of about 15 min, is available from Lincoln Electric Co, Cleveland, Ohio, at no charge except transportation by all interested industrial organizations, technical societies, schools, etc.

Aluminum Co of America announces a new film, entitled *Curiosity Shop*. This movie portrays the long and patient research struggle to make aluminum more useful. The picture was produced in technicolor by Wilding Picture Productions Inc. Prints, of 16 and 35 mm, will be available for school, church and club showings. Requests should be made to: Motion Picture Dept, Aluminum Co of America, 801 Gulf Bldg, Pittsburgh 19, Pa; Modern Talking Picture Service, 9 Rockefeller Pl, New York 20, N. Y.; or Farm Film Foundation, 1731 Eye St, N W, Washington 6, D. C.

Committee on Engineering Education of Compressed Air and Gas Institute, 1404 Terminal Tower, Cleveland, Ohio, announces a 30-min illustrated lecture on compressed air power and its modern industrial applications. Produced primarily as a teaching aid requested by engineering schools and colleges, and reviewed by a group of engineering professors, *Compressed Air in Action* contains 61 illustrations in either 35-mm continuous strip film or 2x2-in. film slides. The lecture is available at cost to industrial organizations, technical societies, high schools, foremen's clubs, service clubs and any other interested groups. All inquiries regarding *Compressed Air in Action* should be addressed to Committee on Engineering Education, Compressed Air and Gas Institute, Room 1404, Terminal Tower Bldg, Cleveland 13, Ohio. The descriptive brochure will be sent on request.

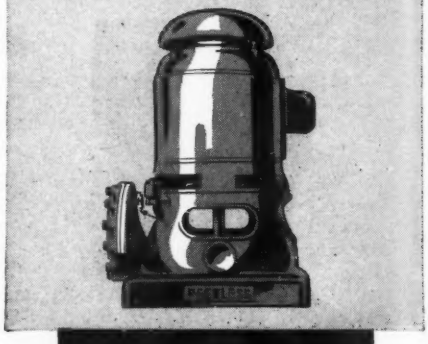
Atomic Energy Commission recently announced in Berkeley, Calif., that it will finance construction of a 110-ft cyclotron, largest in the world, at the Radiation Laboratory on University of California's Berkeley campus. The new atom smasher will be 17 times as powerful as the laboratory's 184-in. model, currently the world's largest. The new cyclotron, which will accelerate protons and other atomic nuclei to speeds of up to 6,000,000,000 electron volts, is expected to be completed in about five years. It will cost $9,000,000 and will have a ring-shaped magnet, requiring about 10,000 tons of steel, which will operate from a 5000-kw power source.

Young Radiator Co announces purchase of Atlas Imperial Diesel Engine Co plant and facilities at Mattoon, Ill. Young Radiator Co manufactures heat-transfer products and has large plants and offices at Racine, Wis., with sales and engineering offices in principal cities from coast to coast.

We'll help you engineer the correct *pump to your application*

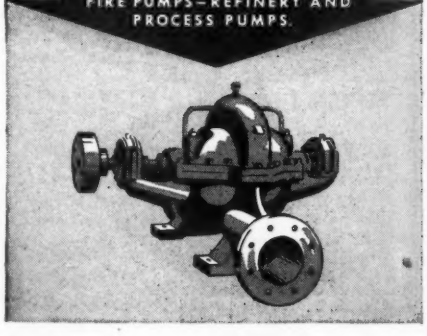
VERTICALS

VERTICAL DEEP WELL AND CLOSE-COUPLED TURBINE PUMPS—HYDROFOIL PROPELLER AND MIXED FLOW PUMPS—MINE PUMPS—HI-LIFT PUMPS—UNDERWRITERS' APPROVED VERTICAL FIRE PUMPS—DOMESTIC WATER SYSTEMS.



HORIZONTALS

GENERAL PURPOSE PUMPS—BOILER FEED PUMPS—SEWAGE PUMPS—CHEMICAL PUMPS—UNDERWRITERS' APPROVED FIRE PUMPS—REFINERY AND PROCESS PUMPS.



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FOR MOST SERVICES fmc PEERLESS PUMPS IN ALL INDUSTRIES

Peerless manufactures pumps in both vertical and horizontal types for most services in *all* industries. Bulletins describing individual applications of each of these types of pumps are available on request.

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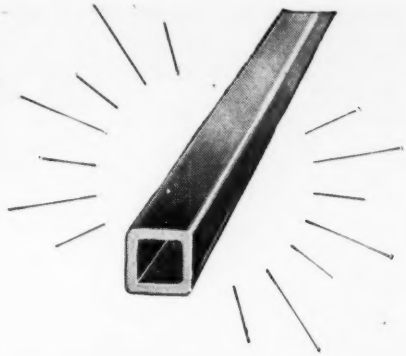
FOOD MACHINERY CORP.

Factories: Los Angeles 31, Calif.; Quincy, Ill.; Indianapolis, Ind. *District Offices:* Chicago 40, 4554 N. Broadway; New York 5, 37 Wall St.; Atlanta Office: Rutland Bldg., Decatur, Georgia; Dallas 1, Texas; Fresno, Calif.; Los Angeles 31, Calif. *Distributors in all Principal Cities*

Chase square copper tube bus has great mechanical strength . . .



ALLOWS LONGER SPANS BETWEEN SUPPORTS

SAVINGS in time and cost of installation are often possible if Chase Square Copper Tube Bus Conductors are used. The square construction gives maximum mechanical strength *in all directions.*

High structural strength permits longer spans between supports. Ease of assembly and erection add to the saving in time and money. Since these square copper tubes have four flat sides, adequate and uniform pressure can be exerted between the large contact surfaces, resulting in firm, secure joints. They may be joined by clamping, bolting, or brazing.

That's why we say Chase Square Copper Bus Tubes are the finest you can buy. Write for full specifications and details.

LOOK AT THESE *Advantages*

1. Made of high electrical conductivity copper resulting in high thermal conductivity, low voltage drop and power loss per pound of metal.
2. Square construction provides maximum structural strength; essential in withstanding the very large forces caused by heavy short circuit currents.
3. Four flat sides allow adequate and uniform pressure to be exerted between the large contact surfaces, resulting in firm, secure joints.
4. Square, one-piece construction enables you to assemble conductors, fittings and supports without difficulty.
5. Copper is well known for its excellent resistance to corrosion.

Chase *the Nation's Headquarters for* BRASS & COPPER

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THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

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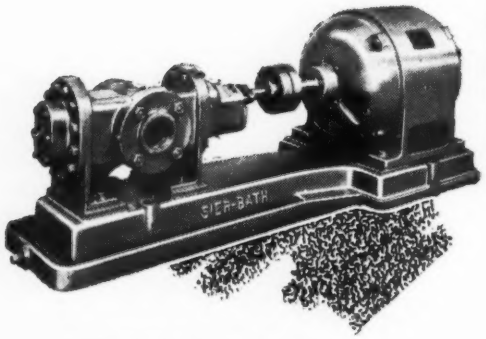
Can a pump be TOO GOOD?

WE believe that no pump used in industrial processes can be too good. The cost of only one shutdown for pump replacement or repair often exceeds the difference in price between the best pump it is possible to obtain—and the second-best.

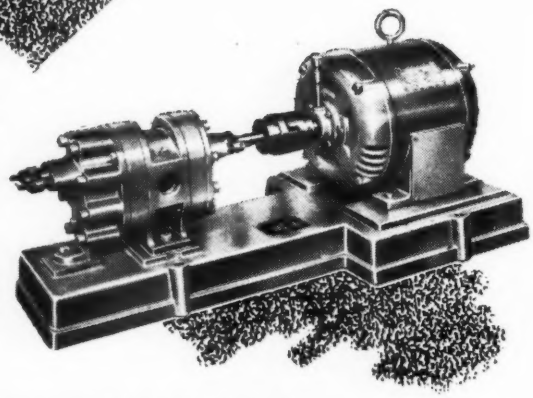
That is why we put *everything* that engineering ingenuity can devise into Sier-Bath Screw Pumps and Gearex Pumps. As a result, Sier-Bath Pumps are noted for their dependability and durability and for requiring the absolute minimum in down-time for maintenance.

Sier-Bath Screw Pumps and Gearex Pumps are made in a modern plant under the best working conditions, by a company that has long been noted for the manufacture of precision gears. In the making of our pumps we adhere to the rigid standards of high quality that have made Sier-Bath Precision Gears famous among manufacturers of quality products. Send for booklet on Sier-Bath Screw Pumps or Sier-Bath Gearex Pumps.



SIER-BATH Screw Pump Advantages: Pulseless flow, anti-friction bearings, vibrationless operation, low maintenance costs, rugged construction. Pumps acetate, asphalt, brines, bunker C fuel oil, cellulosics, greases, molasses, syrups, lube oil, etc.

SIER-BATH Gearex Pump
Advantages: balanced axial thrust, vibrationless operation, roller bushings for precision running under load. Pumps oils, varnishes, solvents, molasses, chemical solutions. Capacities 1-550 g.p.m. Discharge 250 p.s.i. for medium or high viscosities, 50 p.s.i. for water.



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GEAR and PUMP CO., Inc.

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BOOKLETS

RESUME OF BUREAU OF MINES RESEARCH AND DEVELOPMENT WORK ON WESTERN COALS, 1942-47. *By V F Parry, Bureau supervising engineer, Golden, Colo. This Report of Investigations* 4171 *available on request to Bureau of Mines, Publications Distribution Section,* 4800 *Forbes St, Pittsburgh* 13, *Pa. Order by report number and title.* Western coal research report describes discovery of two extensive reserves of coking coal, the successful operation of coal and lignite gasification plants, development of safe methods of storing subbituminous coal in open pits, and a beginning on studies of briquetting certain coals.

ANNUAL REPORT OF RESEARCH AND TECHNOLOGIC WORK ON COAL, FISCAL YEAR 1947. *A C Fieldner, chief of Fuels and Explosives Div, and Paul M Ambrose, former assistant chief, Fuels and Explosives Div, Bureau of Mines. Single copies of Information Circular* 7446 *are available from Bureau of Mines, Publications Distribution Section,* 4800 *Forbes St, Pittsburgh* 13, *Pa.* Outstanding achievements of the Bureau are recorded in the report, which is the 12th annual review of research and technologic work on coal. The Bureau's broad field of research included coal mining and exploration, coal sampling and analysis, gas-and-dust explosion research, coal preparation and storage, and coking and gasification studies.

MAP OF PRINCIPAL NATURAL GAS PIPELINES IN U. S. 44x56 *in., with one inch representing about* 60 *miles, printed in* 12 *colors on heavy map paper for framing,* $5. *When ordering, refer to map as* FPC-M-7. *Federal Power Commission, Washington* 25, *D. C.* Map shows the principal natural-gas pipelines in U. S. as of 1947. It includes information that makes it possible to trace flow of natural gas from its source to point of consumption. Pipelines authorized, but not yet constructed, are also shown.

THE INVESTIGATION OF INDUCTION HEATING IN RELATION TO INDUSTRIAL GAS HEATING. *By S L Case, L R Jackson and R J Lund, Battelle Memorial Institute, Columbus, Ohio. Sponsored by American Gas Assn, Committee on Industrial and Commercial Research, Ralph L Manier, chairman.* 48 *pp,* 11x8½ *in., paper,* $1. *American Gas Assn,* 420 *Lexington Ave, New York* 17, *N. Y.* This report is divided into four sections. First, second and third sections outline salient technological features of each type of heating and describe a few commercial examples of each kind that have proved outstandingly successful. Purpose of these sections is to present examples of well-engineered installations of various types of heating. A fourth section attempts to present an appraisal of metallurgical and economic factors that will be important in deciding which method is most suitable for future installations.

AMERICAN STANDARD SAFETY CODE FOR CONVEYORS, CABLEWAYS, AND RELATED EQUIPMENT. *Send* 90¢ *for copy of* B20.1-1947 *to American Standards Assn,* 70 *E* 45*th St, New York* 17, *N. Y.* The first nationally acceptable safety provisions have been made available for construction and operation of mechanical conveyors and conveying equipment. Safety provisions for all kinds of conveyors are included in the new standard. Special provisions for safe operation are given for each type. The safety

correct

FUEL-AIR RATIO
FUEL FEED OVER-FIRE DRAFT

GET ALL *Three* AND HAVE THESE RESULTS

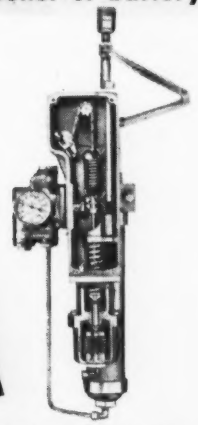
1 More steam from your present boiler.

2 Less fuel — coal — oil — gas reauired.

3 Savings in maintenance whether you have a single boiler or battery of boilers.

WHETHER YOU HAVE ONE OR A BATTERY OF BOILERS . . . . INSTALL

CASH STANDARD
AUTOMATIC COMBUSTION CONTROL SYSTEMS



CASH STANDARD FUEL FEED CONTROLLER • • •

Automatically Regulates Fuel Feed

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion —hence, money saving.

Bulletin No. 300
Shows Applications
. . . Tells How the System
Works in Your Favor

Tells about Correct fuel feed — Correct fuel-air ratio — Correct over-fire draft and how you get all three. It shows applications and how various CASH STANDARD Units can be made to meet any specific condition and work on any boiler or stoker with any kind of fuel.

•

Send for it

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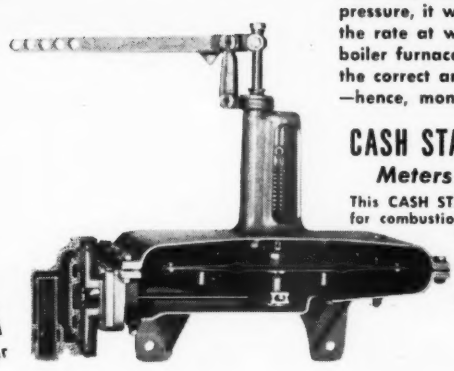


CASH STANDARD AIR FLOW CONTROLLER • • •

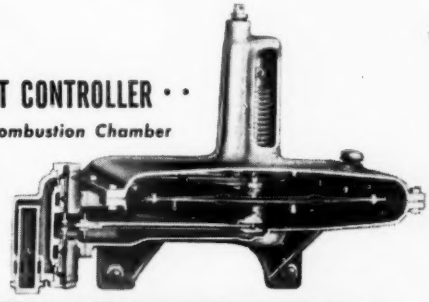
Meters the Air Needed for Combustion

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

CASH STANDARD FURNACE DRAFT CONTROLLER • •

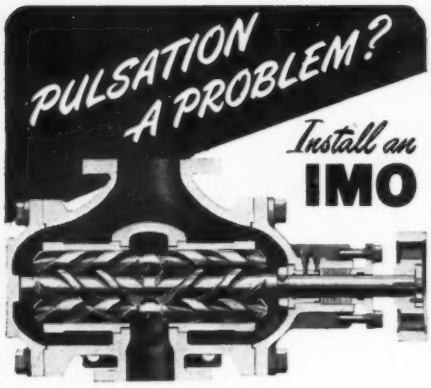
Maintains a Constant Draft in the Combustion Chamber

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD
CONTROLS . . VALVES



With an IMO Pump delivery is not interrupted by the periodic strokes of a piston or the opening and closing of valves and ports. The turning of the rotors in an IMO forces the fluid from suction to discharge in a continuous, uniform flow.

IMO pumps can be furnished for practically any capacity and pressure required for oil, hydraulic-control fluids, other liquids.

Send for Bulletin I-145P.

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of solid selling!

The new POWER Buyers' Guide will work for you, day by day, for a full year—while your prospect is in the buying mood . . . designing new plants, specifying additions, selecting replacements, ordering maintenance parts and equipment.
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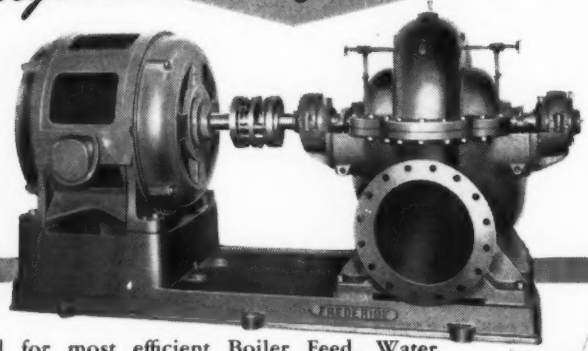
FREDERICK CENTRIFUGAL PUMPS

Engineered to fit your job!



Designed for most efficient Boiler Feed, Water Works, Circulation, Drainage or General Service . . . Capacities up to 20,000 G.P.M. . . . Heads up to 600 P.S.I. . . . Open, Splash proof or totally enclosed ball bearing motors and steam turbine drive . . . In constant use today by many leading power plants.

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IRON AND STEEL, INC.
Pump Division — Frederick 4, Md.

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—Send for these attractive, colorful booklets which give details of construction and operation of Frederick Pumps. They'll show you how Frederick Pumps are engineered to fit your job. Ask for Bulletins 103 & 104.

ALSO MANUFACTURERS OF FRECUT AND FREFORM METALWORKING MACHINERY, FREDERICK STOKERS AND ASH CONVEYORS AND A COMPLETE LINE OF GRAY IRON CASTINGS.

of the worker or operator is given first consideration, but the efficient use of the conveyor has also been kept in mind in selecting guards and other safety devices.

OVERFIRE JETS IN ACTION FOR SMOKE ABATEMENT. 11x8½ *in., paper. Bituminous Coal Research, Inc,* 912 *Oliver Bldg, Pittsburgh* 22, *Pa. Single copies are available without charge. Additional copies are available at* 25¢ *each from National Coal Assn,* 803 *Southern Bldg, Washington* 5, *D. C.* Booklet presents representative existing installations to prove effectiveness of modern overfire jets to reduce smoke from commercial and industrial furnaces. Part of text is in question-and-answer form.

STANDARD RULES FOR FIELD WELDING OF STEEL STORAGE TANKS (1947). 19 *pp, paper,* 50¢. *American Welding Society,* 33 *W 39th St, New York* 18, *N. Y.* Bulletin contains standard requirements for arc- and gas-welded construction of bulk storage tanks for holding liquids at substantially atmospheric pressure. The new edition contains revised materials standards and makes provision for welding-plate thicknesses up to 2 in. Revisions have also made in the requirements for inspecting shell joints by sectioning methods.

The Rules contain complete provisions for welding, including material, design, workmanship and inspection requirements. An appendix refers to the general specifications covering the unit stresses and other requirements.

50TH ANNIVERSARY—1948. 48 *pp,* 11x8½ *in., paper. Available from Burns & McDonnell Engineering Co, 95th and Troost Ave, Kansas City, Mo.* Booklet discusses history and progress that Burns & McDonnell has achieved since its inception 50 years ago. Included are photos of projects completed in different parts of the country.

Contracts recently awarded to Westinghouse Electric Corp by Bureau of Reclamation for three additional 108,000-kw generators will make Grand Coulee Dam the world's largest producer of electricity at one location. When installed in 1950, these generators will bring Coulee's installed rated capacity to 1,620,000 kw, equivalent to 2,170,000 hp. Westinghouse has built all the existing generators for Grand Coulee to date. Westinghouse also holds contracts for building and installing the first three units for the east powerhouse, slated to go into service during 1949. With addition of three generators in 1950, there will be a total of 15 units installed in the two powerhouses. Only three more units are required to complete the present specifications for 18 units.

Trane Co, La Crosse, Wis., manufacturer of heating, cooling and air-conditioning equipment, has completed plans for construction of an Eastern branch factory at Scranton, Pa. This new plant will be used as soon as it is completed to meet the demand for Trane *Convector*-radiators. Other products produced by the company may be fabricated in the new plant at a later date.

Moorhead-Reitmeyer Co, 30th and Brereton St, Pittsburgh, Pa., has changed its name to **Moorhead Electrical Machinery Co.** W L Moorhead continues as president.

Able Helmsmen Needed-

WITH our way of life threatened and even our motives for helping others discredited, we drift toward destruction of the very thing that makes America the envy of the world --individual liberty. Who can steer our course, to save our craft from wreck?

It is *your* job. You, as a leader in your community, must help arouse public opinion to a full appreciation of America's sacred heritage of freedom for the individual. You owe it to yourself, your family, your neighbor and your nation, to give of your experience and knowledge to pilot us safe through the storm.

These tempestuous times demand the intelligent work of leaders in every community to preserve America as the impregnable vessel of liberty and freedom. Here then, is important work for able helmsmen.

The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio

Export Offices--500 Fifth Avenue, New York

MANUFACTURERS OF CARBON, ALLOY AND YOLOY STEELS

COLD FINISHED CARBON AND ALLOY BARS - SHEETS - PLATES - WIRE - TIE PLATES AND SPIKES - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - PIPE AND TUBULAR PRODUCTS - CONDUIT - BARS - RODS.

The ALCO PLAN for

Flexibility and Low Cost Offered by ALCO Standardized Engine

■ The ALCO plan for Diesel economy was developed to help solve the problems of many diesel plants where flexibility, economy, dependability, and provision for future growth are particularly important.

By concentrating on one size of stationary Diesel engine, ALCO now offers unusual advantages for applications where multiples of 540 to 1,300 horsepower can be used.

Low Cost...Because this famous design is also used, with slight modifications, in ALCO switch engines, quantity production brings both first cost and the cost of replacement parts unusually low.

Flexibility...The use of one size of engine gives plant operators wide range plus the ability to fit fluctuating load curves more closely than could be done with fewer engines of larger size, or of varied capacity.

Less Wear...This more efficient use of engines means that less wear per installed horsepower is necessary, since the unused capacity of operating engines at any time need not be more than about the capacity of one engine, and there is no wear on the idle engines. Larger engines would necessitate greater wear per installed horsepower, with resulting higher costs.

Greater Efficiency...With engines operating near rated load, efficiency is greater, fuel consumption less, and better operating conditions are maintained.

Uniform Engine Wear...With several units of the same size, engines can be operated in rotation, thus keeping wear approximately the same in all engines, and allowing a planned program of inspection and maintenance with minimum "down time" and inconvenience.

Stand-by Economy...When all units are the same size, stand-by capacity can be limited to one size of engine the same as all others. With a variety of engine sizes, stand-by capacity might easily have to equal the largest single unit.

Simplified Maintenance...Uniform engine size means uniformity of replacement parts; uniformity of maintenance and inspection procedures; interchangeability of many parts; smaller stocks of replacement parts; minimum cost of special tools and equipment; and shorter "down time."

Easy Growth...As demand increases, gradual growth can take place by adding extra units of the same size.

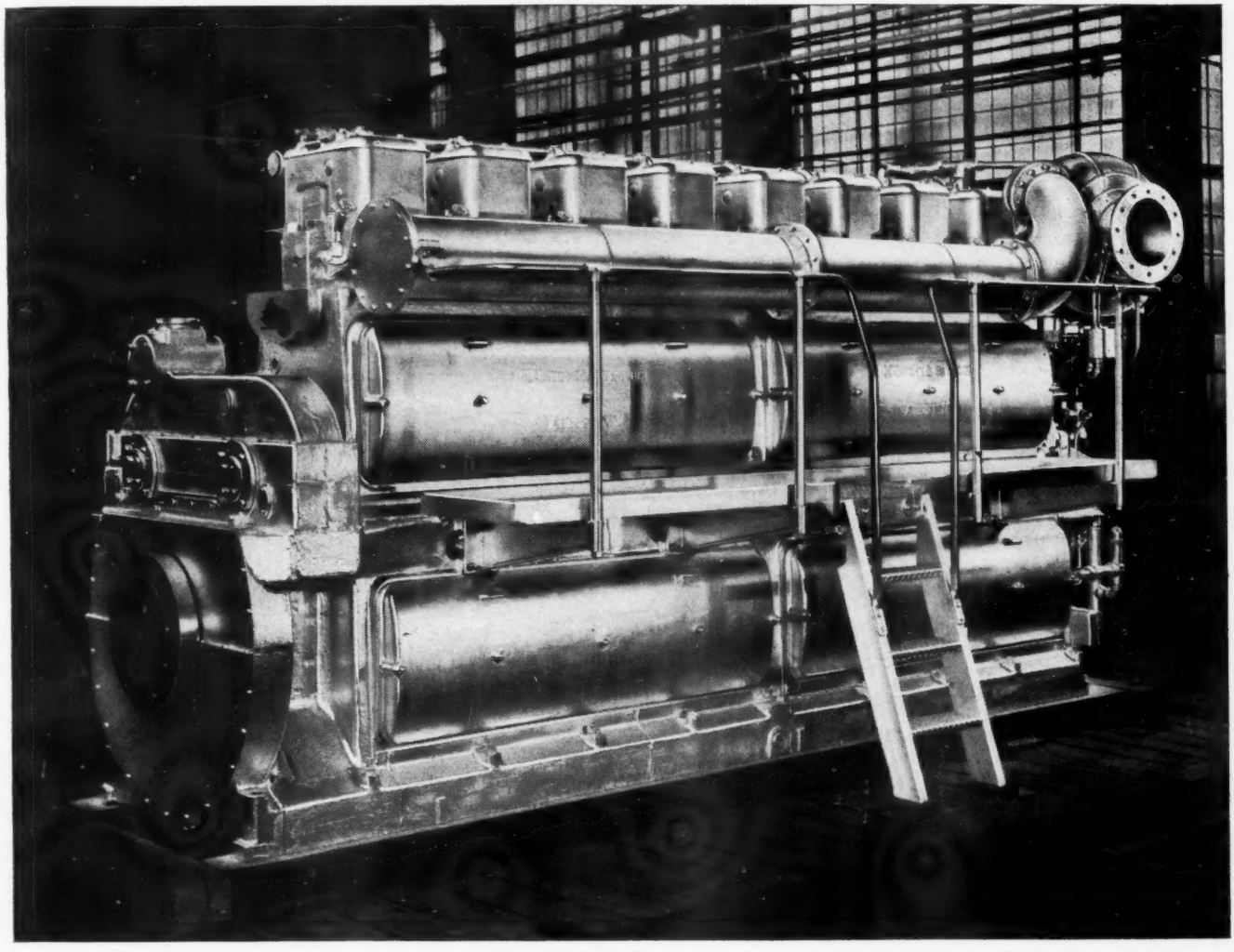
What About Speed?

Wear...Much has been said about diesel-engine speed versus maintenance. But in actual practice, slow-speed engines and medium-speed engines of the same horsepower rating have almost the same piston-travel and journal-travel per minute.

AMERICAN LOCOMOTIVE COMPANY
Department D 4
30 Church Street, New York 7, N. Y.

ALCO STANDARDIZED

DIESEL ECONOMY



Thus it seems obvious that wear problems should be very similar—with speed having little influence.

Economy of Space...The space-saving advantage of a medium-speed engine is more than ordinarily important today because of the high cost of buildings—including foundations.

How Much Can You Save?

By using the ALCO plan, and standardizing on ALCO low-cost engines, you can very likely make substantial savings as compared to other approaches to your problem.

What your actual savings can be with this compact, efficient engine should be computed carefully. Call in an ALCO engineer to discuss the ALCO plan in relation to your needs.

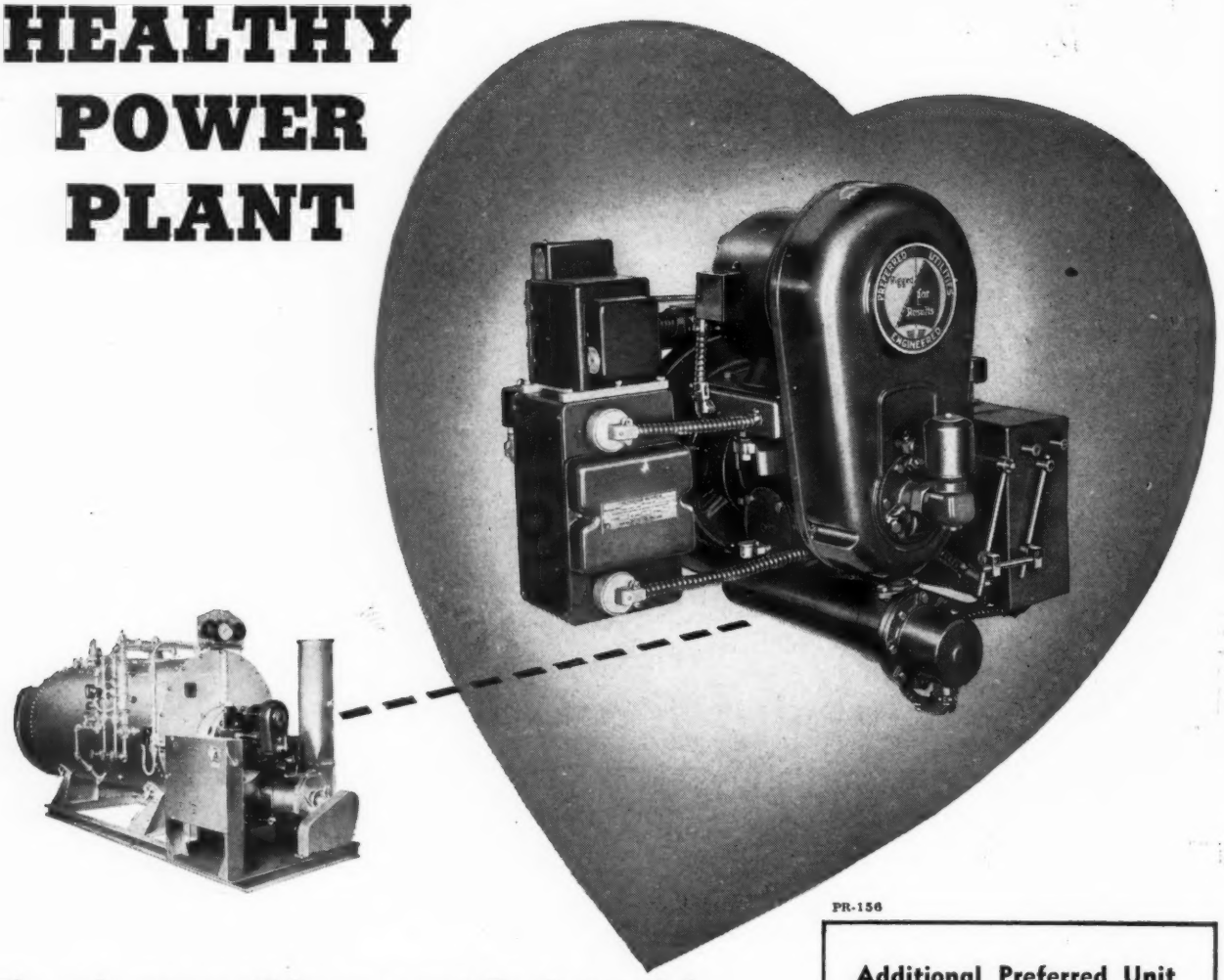
DIESEL ENGINES

American Locomotive

THE MARK OF MODERN ENGINEERING

This Steady Heart Means a

HEALTHY POWER PLANT



PR-156

The only rotary oil burner specially designed for firing in the elongated furnace of a "packaged" boiler.

The Preferred Horizontal Rotary Oil Burner is the "heart" of the Preferred Unit Steam Generator . . . a heart that steadily supplies the correct amount of oil for economical combustion.

Constant volume of fuel oil—regardless of variations in temperature, pressure, or viscosity of the oil—is assured by the patented "Voluvalve" fuel regulation and the dual pump reservoir.

Ignition is reliable and automatic, due to the low-voltage hot-wire igniter assembly. Thorough atomization of heavy oils is provided by the higher cup speeds, made possible by the high-speed belt drive.

Maximum combustion efficiency is achieved throughout the entire throttle range by an air control device coordinated with oil feed control. Automatic high-low operation is standard on all Preferred Unit Steam Generators of 100 H.P. and over, and is also available on smaller units.

Preferred's Bulletin 175 tells the complete story of the Preferred Horizontal Rotary Oil Burner . . . and Bulletin 1000-E describes in detail other engineering features of the Preferred Unit Steam Generator.

Additional Preferred Unit Steam Generator Features

1. Induced (pull-through) Draft—eliminates necessity of building expensive stacks. Only a simple vent to the outside air required. No escape of products of combustion into the boiler room.

2. Fully Automatic Operation — even with Bunker C or No. 6 oil.

3. Four-pass Down-Draft Gas Travel—results in maximum heat absorption.

4. 80% Minimum Thermal Efficiency—proved and guaranteed.

5. Full Range of Sizes—from 20-500 H.P., and pressures of 15 to 200 lbs. Two-pass units in 20 and 30 H.P., 15 lbs. pressure.

Four-pass units also available in all sizes for 250 p.s.i.g. design on special order. Write for complete details of these special units.

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PREFERRED UTILITIES MANUFACTURING CORPORATION, 1860 Broadway, New York 23, N. Y.

PREFERRED UTILITIES MFG. CORP.

Another Contribution to Better Coal by *Heyl & Patterson*

The Thorsten Automatic COAL SAMPLER

IN ORDER TO PROPERLY EVALUATE the performance of boilers and generating equipment ***Energy Input*** must be measured by obtaining an accurate analysis of coal. Such an analysis depends upon a true, continuous sampling of coal.

Thorsten, the modern, automatic Coal Sampling System, obtains accurate samples of coal at predetermined short intervals continuously during the operation of coal handling equipment.

It is a self-contained, sturdily-built unit, easily installed. It is flexible, readily adaptable to existing or new conveying systems. Simple to operate, it can be used with belt or flight conveyors and chutes. The space required between two belt conveyors for entire Sampler and Crushing equipment is only slightly more than the minimum requirements for delivering from one belt to the other. In all conveyor systems the surplus material from the Crusher can be returned to the main conveying system without auxiliary units.

STATIONARY SAMPLER for narrow streams of coal

RECIPROCATING SAMPLER for wide streams of coal

What Makes it TICK

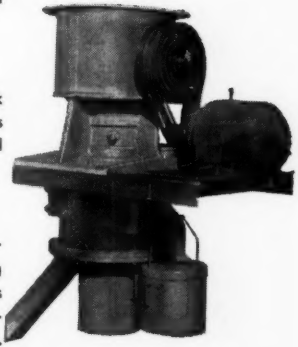
A hollow Sampling Spoon is inserted in the coal stream. The longitudinal slot of the spoon is normally on the underside, opposite to the flow of the coal. At predetermined intervals, for example, every two minutes, the spoon makes one complete revolution, exposing the slot to the falling coal. The coal enters the slot and travels through the hollow spoon to the Sampling Crusher.

RECIPROCATING SAMPLER

The Sampling Spoon of the Reciprocating Sampler travels slowly back and forth, through the full width of the coal stream, obtaining samples at regular intervals. The sum of these samples in one cross travel represents a true section of the coal on the belt or chute.

THORSTEN SAMPLING CRUSHER

Through two stages of crushing it reduces coal to proper size for laboratory use and at the same time it takes samples from the coal being crushed, so that a small, true sample is collected at the end of a day's run. It is an accurate sampling and quartering device, entirely eliminating the human element and giving results that are definitely uniform.



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Railroad Car Dumpers } High Lift-Turnover-Rotary
Coal Preparation Plants
Coal & Coke Handling Equipment
Boat Loaders and Unloaders
Rotary Mine Car Dumpers
Coal Crushers
Coal Storage Bridges
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Bradford Breakers
Refuse Disposal Cars
Thorsten Coal Samplers
Kinney Car Unloaders
Pig Iron Casting Machines

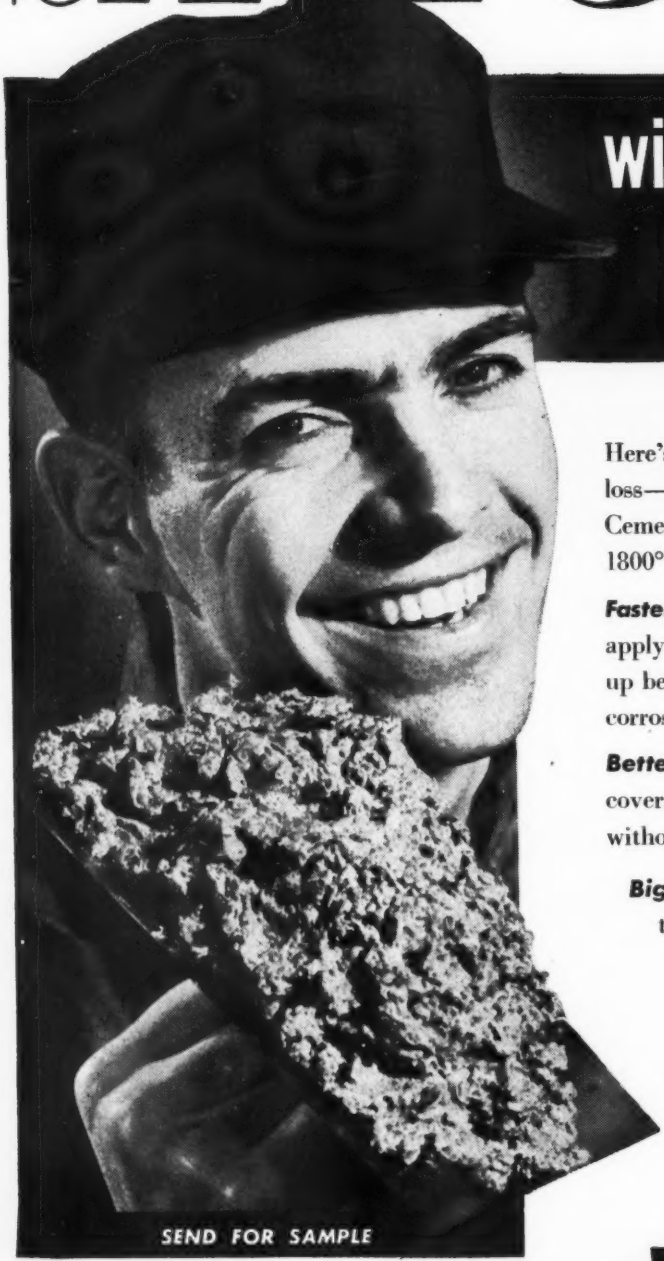
Heyl & Patterson, Inc.

"SINCE 1887"

55 WATER STREET · PITTSBURGH 22, PA.

SAVE 3 Ways

with B-H No. 1 Cement
for insulating valves and other irregular surfaces



Here's the insulating cement that makes it practical to stop heat loss—even on areas that must be occasionally serviced. B-H No. 1 Cement is efficient, easy to use and resists temperatures up to 1800° F.

Faster to use. With B-H No. 1, you simply add water, mix and apply. *It sticks instantly!* It won't slide off bottom surfaces or roll up behind the trowel. Special rust inhibitor prevents pitting and corrosion.

Better coverage. B-H No. 1 is economical to use—with a wet coverage up to 60 square feet, 1-inch thick per 100 pounds! It dries without cracking or peeling. And it's reclaimable up to 1200° F.

Bigger heat savings. B-H No. 1 stops heat loss, even at high temperatures—because it's compounded of *black* Rockwool. For example, a 3-inch application reduces 800° F to 150° F.

There are hundreds of places where you can turn heat losses into profits with B-H No. 1 Cement. Send the coupon for descriptive literature and a working sample.

SEND FOR SAMPLE

BALDWIN-HILL COMPANY
734 Breunig Avenue, Trenton 2, N. J.
Send free sample of B-H No. 1 Cement and 24-page data book "Industrial Relations."

NAME.....POSITION.....

FIRM .....

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Baldwin-Hill

Specialists in Thermal Insulation

B-H MONO-BLOCK

B-H BLANKETS

B-H WEATHERSEAL

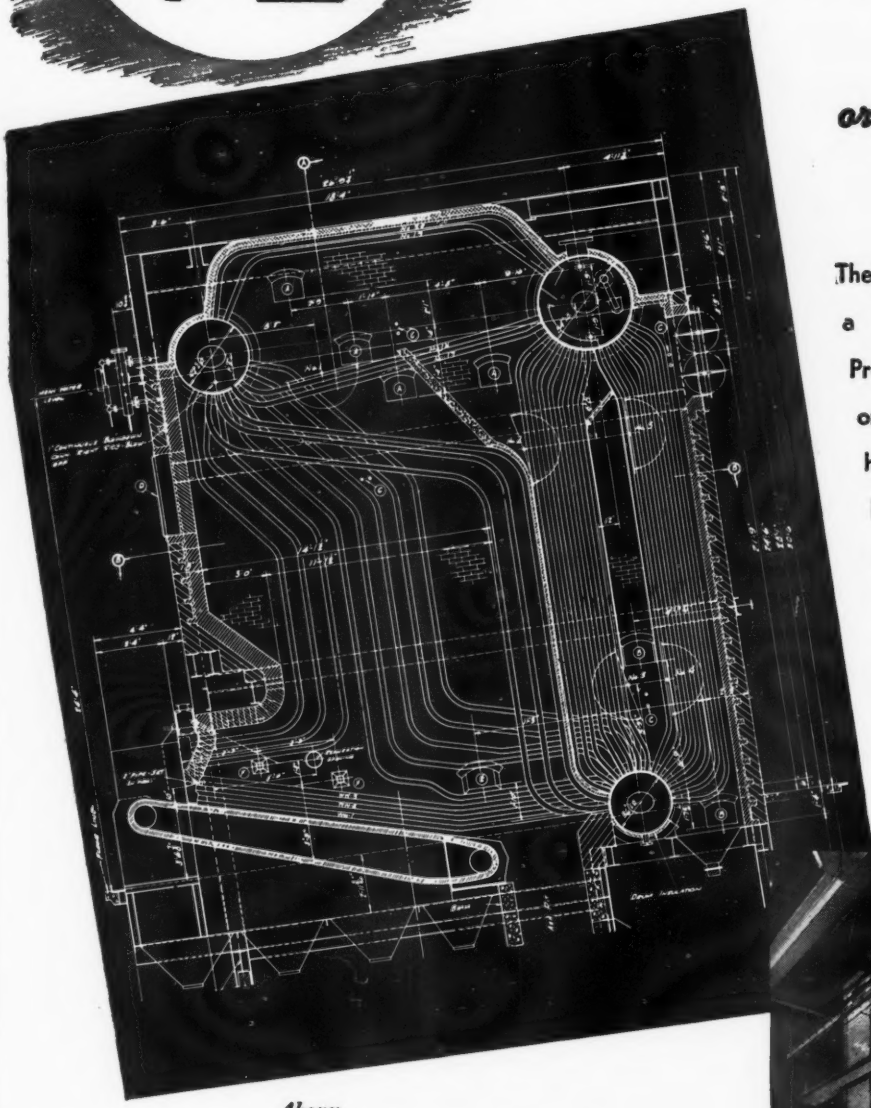
B-H FELTS

CLASS **VL**

Vogt

Steam Generating Units

for POWER *or* PROCESSING LOADS, *and* HEATING



The design provides large furnace volume and a high ratio of radiant heating surface. Proper combustion is assured with any fuel or method of firing. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Vogt Class VL Steam generating units are giving satisfactory service in Hotels, Sugar Refineries, Steel Mills, Furniture Factories, Distilleries, Oil Refineries, and related industries. A bulletin showing typical installations will be sent upon request.

Above:
This 90,000 lbs. steam per hour unit, designed for 475 lbs. pressure, serves the Mansfield Tire & Rubber Co., Mansfield, Ohio.

Right:
Two 515 H.P. units installed in Brown-Forman Distillers Corporation, Louisville, Ky. Plant.

HENRY VOGT MACHINE CO. • 1000 W. Ormsby St., Louisville 10, Ky.
Branch Offices: New York, Philadelphia, Cleveland, Chicago, St. Louis, Dallas

Large eastern manufacturer connects waste heat boiler and mill with transmission pipe insulated with K&M "Feat'herweight" 85% Magnesia and K&M Hy-Temp.

Superheated steam travels nearly 2 miles

Another job for K&M "Featherweight" 85% Magnesia

Here is a real job for insulation. A 16" superheated steam line almost two miles long at 275 pounds pressure and a temperature of approximately 650°F. Just another case where 85% Magnesia and Hy-Temp Insulation were selected to give maximum results under exacting circumstances.

The pipe line illustrated above presents one of those extreme conditions where insulation is called upon to minimize heat losses with seasonal temperature changes varying from zero to 90°F. In this instance a 3-ply outer covering of Asbestos Roofing Felt is used as a protection against the elements.

K&M Distributors, located strategically throughout the country, are experts on the application of K&M insulation materials. Let them help you gain substantial savings in your plant. Write for full details.

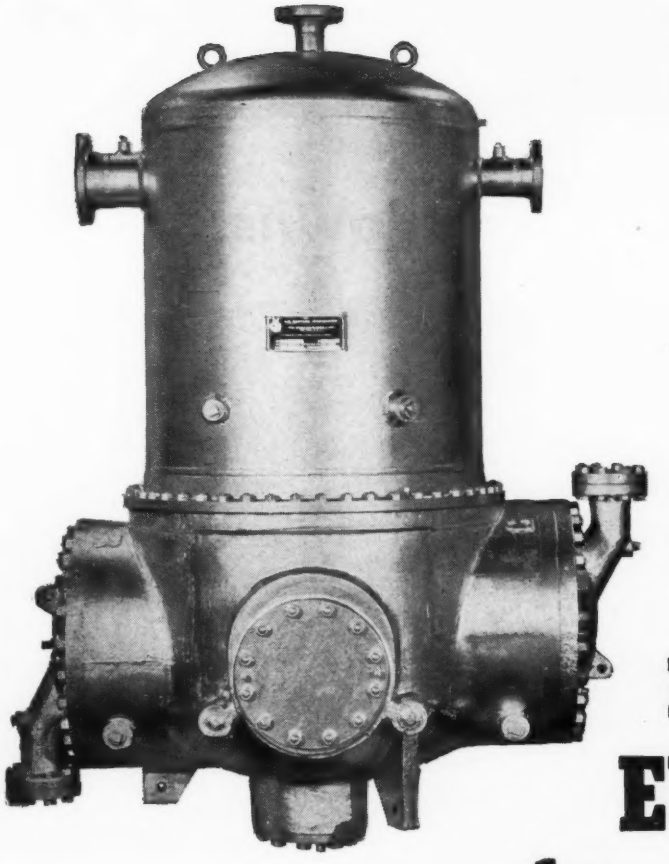
Nature Made Asbestos—

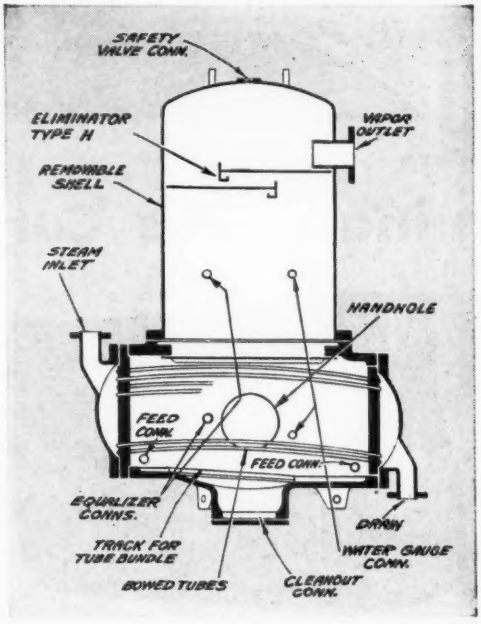
Keasbey & Mattison has made it serve mankind since 1873.

DIAMOND ANNIVERSARY 1873 1948 K&M Heat in asbestos KEASBEY & MATTISON CO.

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

IN CANADA: Atlas Asbestos Co., Ltd., MONTREAL • TORONTO • WINNIPEG and VANCOUVER





Here is your EVAPORATOR for small capacities and low pressures

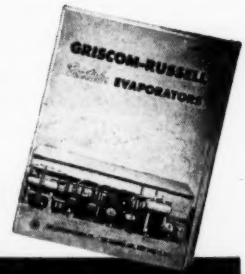
Note These Distinctive Design Features of G-R Type H Bentube Evaporators

- Bentube elements crack off scale by "thermal shock" on changes of temperature and without requiring hand-scaling
- Each individual tube is free to expand and contract independently of others
- Low tube bundle and exceptionally high dome provide large vapor space to insure purity of the vapor produced
- The multiple short tubes assure lowest possible steam pressure drop
- All connections are external to the shell, and there are no bolted joints or piping inside the shell, thereby providing greatest simplicity and convenience
- The tube bundles are readily removable without entering the shell
- Tubes are sloped to be self-draining, and are widely spaced to prevent bridging of scale and to allow free dropping of scale to the bottom of the shell
- The design is adapted to installations where floor space is limited

Out of the Griscom-Russell 78 years of experience in building heat transfer apparatus has come the Type H Vertical Bentube Evaporator . . . specially designed to produce pure distilled boiler feed make-up for the moderate size plant.

The many distinctive features of these units have long proven their advantages in the large high-pressure G-R Bentube Evaporators of which the Type H is an adaptation. These features, some of which are listed in the table, have made G-R Evaporators widely preferred in central power generating stations, modern industrial plants and on shipboard, with installations serving a total of more than 40,000,000 boiler horsepower

Write for Bulletin 364 describing the advantages and applications of G-R Bentube Evaporators in detail.



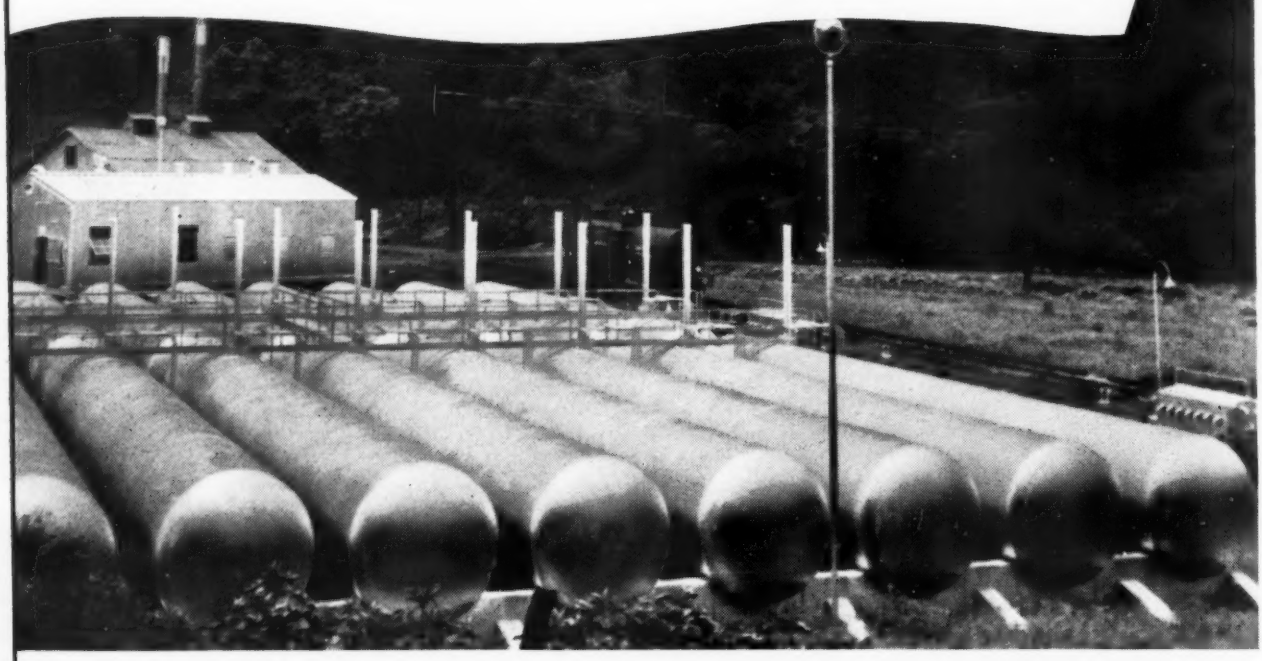
THE GRISCOM-RUSSELL CO.
285 Madison Avenue, New York 17, N. Y.

GR-180

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

Eliminate *Gas Cut-Off* Shutdowns...*



Install a PRITCHARD L.P.G. Standby Plant

***These Advantages are Gained with Your Own L.P.G. Plant**

- Propane-air possesses same heating qualities as natural gas, and can be substituted in industrial systems without burner adjustments.
- Fuel can be delivered by rail or truck at any time and stored for emergency use.
- Complete or partial changeover can be made in a few minutes.
- Butane or propane-butane, liquefied petroleum gas mixtures may be used interchangeably.
- Pritchard Standby Plants are independent units, complete within themselves.
- Pritchard will design, engineer and construct to your specifications, covering all types of fuel.

Experience with last winter's weather and fuel supply failures points up sharply the importance of emergency gas supply. Pritchard Liquefied Petroleum Gas Plants are the economical way to prevent unnecessary production losses and costly shutdowns.

Consult Pritchard NOW, while there is time to consider your needs, furnish estimates and complete construction. Then come what may, *your plant* will continue in profitable operation. The savings will pay the cost.

THREE FUNCTIONS — Engineering, Construction, Manufacturing

IN FIVE FIELDS — Serving the CHEMICAL, POWER, PETROLEUM and GAS industries as well as providing specialized EQUIPMENT for all industries.

NATURAL GAS DIVISION

J.F. Pritchard & Co.

DESIGN • ENGINEERING • CONSTRUCTION

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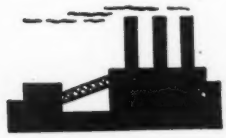


WHATEVER YOUR PIPING NEEDS

shaw PIPING

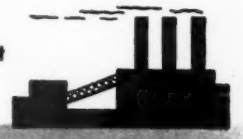
fills them quickly and dependably

DEPENDABLE PIPING PRE-FABRICATION—INSTALLATION

Benjamin F. Shaw Company is qualified to pre-fabricate and erect piping —any place in the United States and Canada.

Lewis F. Shaw III

President



KNOWN SINCE 1893 FOR HIGH QUALITY

BENJAMIN F. SHAW COMPANY • 2ND & LOMBARD STS • WILMINGTON 99, DELAWARE

Still Another CRYSTOLON* Brick Installation

This Time: In a Semet-Solvay Reverse Flow Set

Location: Pawtucket, R. I. plant, Blackstone Valley Gas & Electric Company

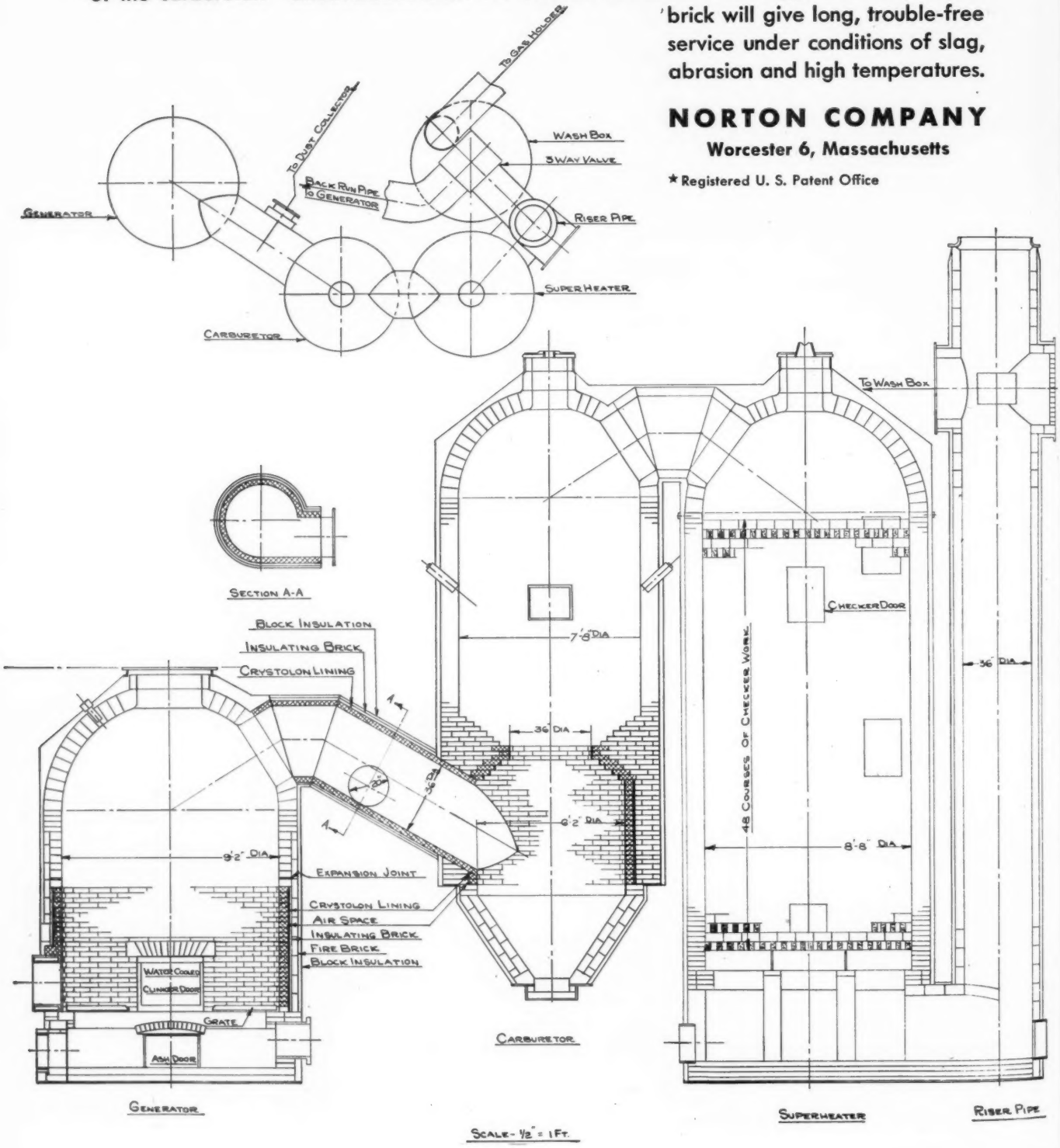
Masonry Contractor: W. J. Gaskill Co., N.Y.C.

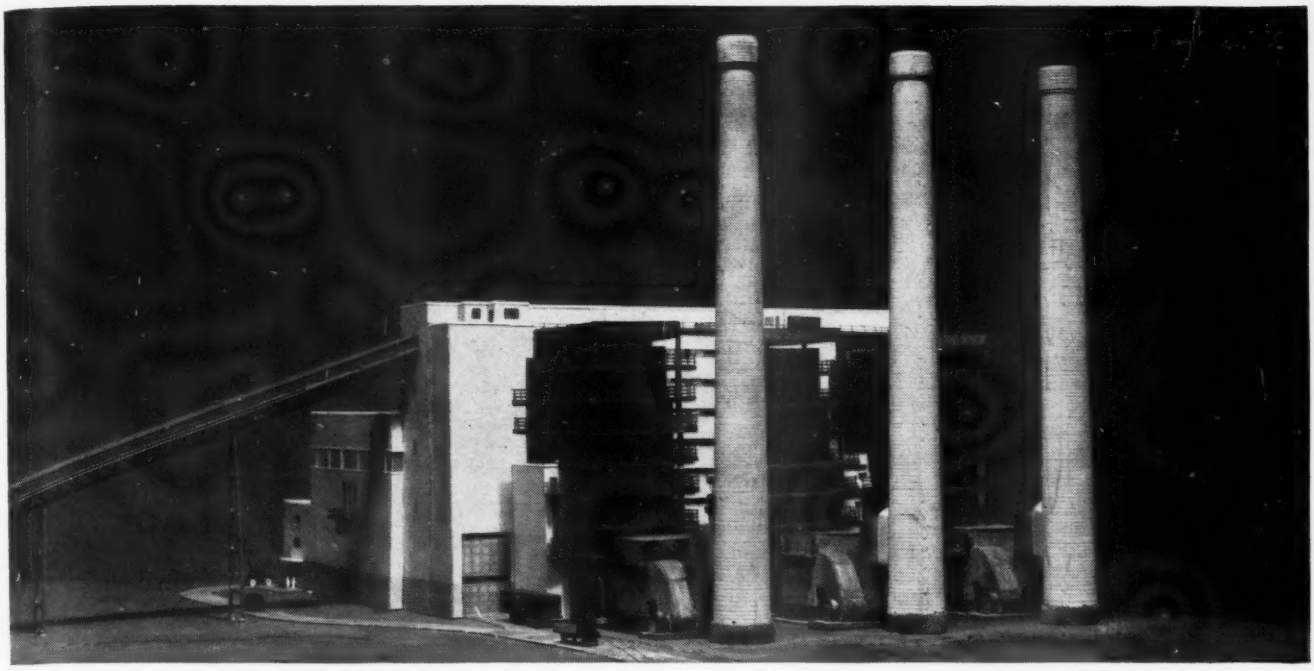
The drawing below shows the installation of CRYSTOLON Brick in a reverse flow, open carburetor type of water gas set. Twenty-four courses of CRYSTOLON Brick were laid in the generator, extending up five feet from the grate line. A full lining of CRYSTOLON Brick were set in the generator offtake, and 28 courses of these brick were laid in the base of the carburetor. CRYSTOLON Brick are selected because these rugged silicon carbide brick will give long, trouble-free service under conditions of slag, abrasion and high temperatures.

NORTON COMPANY

Worcester 6, Massachusetts

★ Registered U. S. Patent Office





World's highest temperature steam generating station to use Timken® tubes in superheater

Public Service Electric and Gas Company, New Jersey, will use Timken tubes for 1050°F. temperature, 1500 psi pressure

Engineers of Combustion Engineering Company were designing the highest temperature steam boiler units in the world for the Public Service Electric and Gas Company, New Jersey. They needed superheater tubes to heat the steam from 650°F. to 1050°F., at a pressure of 1500 psi!

These tubes had to have exceptional strength and superior resistance to corrosion and oxidation. At the same time, Public Service wanted to get maximum tube life per dollar invested.

To meet these conditions, four different Timken alloy steels were selected, each one with the exact physical properties necessary to meet its specific requirements—to give the most dependable service at the most economical cost.

Assured maximum tube life per dollar invested was made possible by The Timken Roller Bearing Company's (1) 18 years of experience and research in high temperature applications, and (2) complete quality control throughout every step of production.

If you would like the help of our Technical Staff (no obligation) write The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

TIMKEN

TRADE-MARK REG. U.S. PAT. OFF.

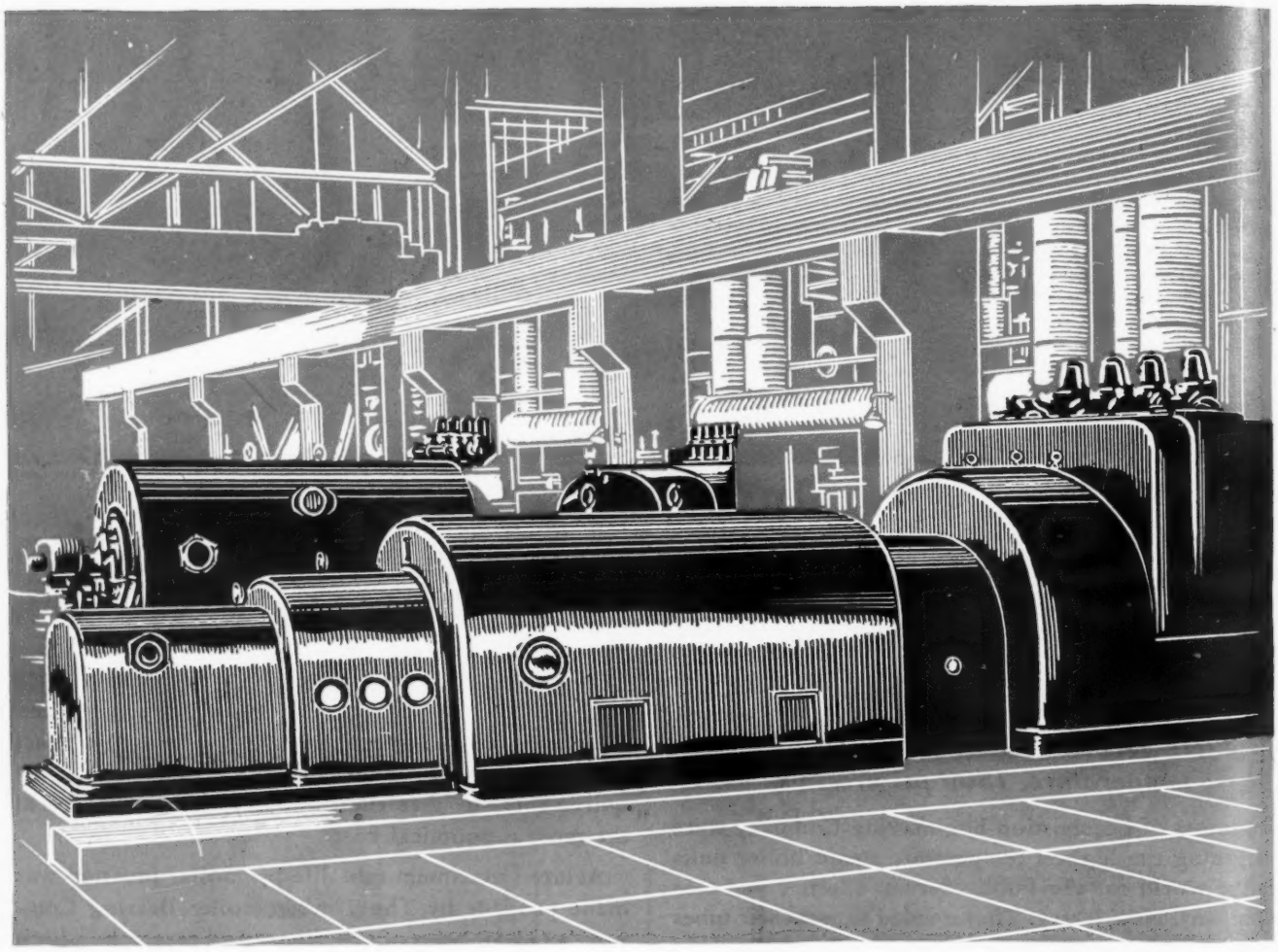
Fine Alloy

STEEL

and Seamless Tubes

Specialists in alloy steel—including hot rolled and cold finished alloy steel bars—a complete range of stainless, graphitic and standard tool analyses—and alloy and stainless seamless steel tubing.

YES! Tycol Aturbrio Turbine Oils perform better . . . BETTER . . . BETTER



Tycol Aturbrio Turbine Oils perform better because:

. . . *Tycol Aturbrio Oils* mean economical and more efficient lubrication plus positive protection against corrosion and rust.

. . . *Tycol Aturbrio Oils* are characterized by exceptionally good oxidation stability and demulsibility . . . they put an end to sludging troubles.

. . . *Tycol Aturbrio Oils* are justly famous for their dependability and endurance . . . have performed superbly in many plants for years without a change.

Complete and detailed information on Tycol Aturbrio Turbine Oils is available from your nearest Tide Water Associated Office. Call or write in today.

TYCOL
INDUSTRIAL LUBRICANTS

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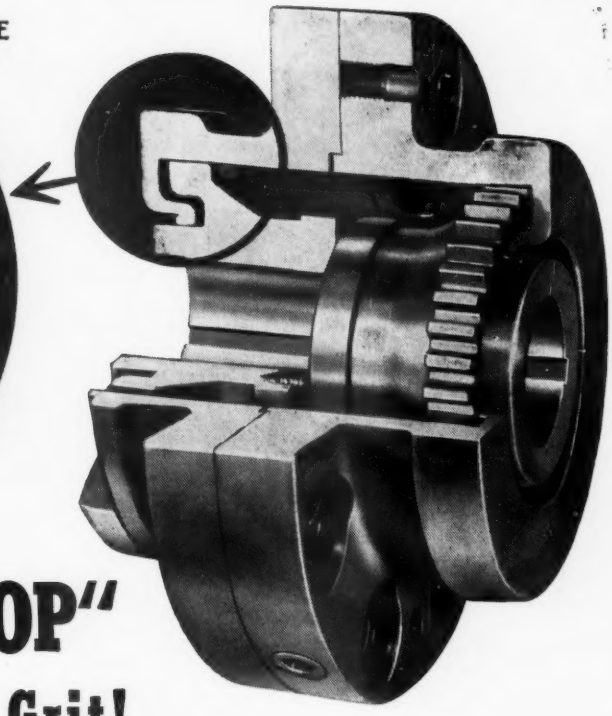
TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE · NEW YORK 4, N. Y.

LUBRICATION — "ENGINEERED TO FIT THE JOB"

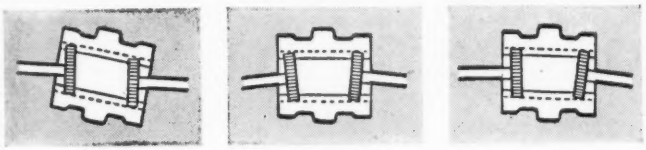


This Metal-to-Metal Seal says "STOP" to Moisture, Dust and Grit!

That's why FAST'S COUPLINGS Give *Continuous* Service!

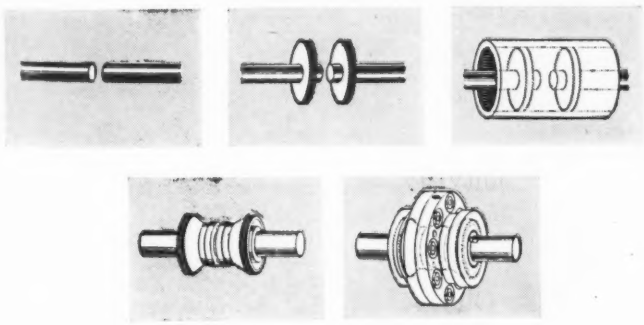
FAST'S self-aligning Couplings are completely free of perishable parts. They're all-steel throughout. At the vital spot shown above, this important feature is achieved through an *exclusive* "rocking bearing." This bearing is exclusive in providing a positive *metal-to-metal* seal that guards the load-carrying oil against troublesome moisture, dust and grit. The bearing is also exclusive in its correctly engineered position which allows *freedom of movement* to compensate for misalignment because its spherical base has the same axis as the hub spline faces. No perishable packing rings are used. There's nothing to wear, nothing to fail. Result: *uninterrupted* power transmission for all your installations!

We have a complete line of couplings for immediate delivery. No matter which type of Fast's Couplings you buy, you get the benefits of years of top engineering experience, Koppers' high standard of workmanship and unexcelled coupling service which assures you of spare parts no matter how old your couplings may be. That means longer machine life, lower upkeep costs, minimum shutdown losses! Koppers Co., Inc., Fast's Coupling Dept., 247 Scott St., Baltimore 3, Md.



Compensate For All Misalignment

The floating sleeve takes a neutral position. All forms of misalignment are compensated for between the lubricated faces of the splines, equally divided between driving and driven members. The entire assembly revolves as one unit.



Simple As A-B-C

Fast's self-aligning Couplings are amazingly simple for the important job they handle. A splined hub on each shaft end. A sleeve with internal splines to mesh. Oil in the sleeve, kept between the splines by centrifugal force, carries the load between the splines.

K KOPPERS

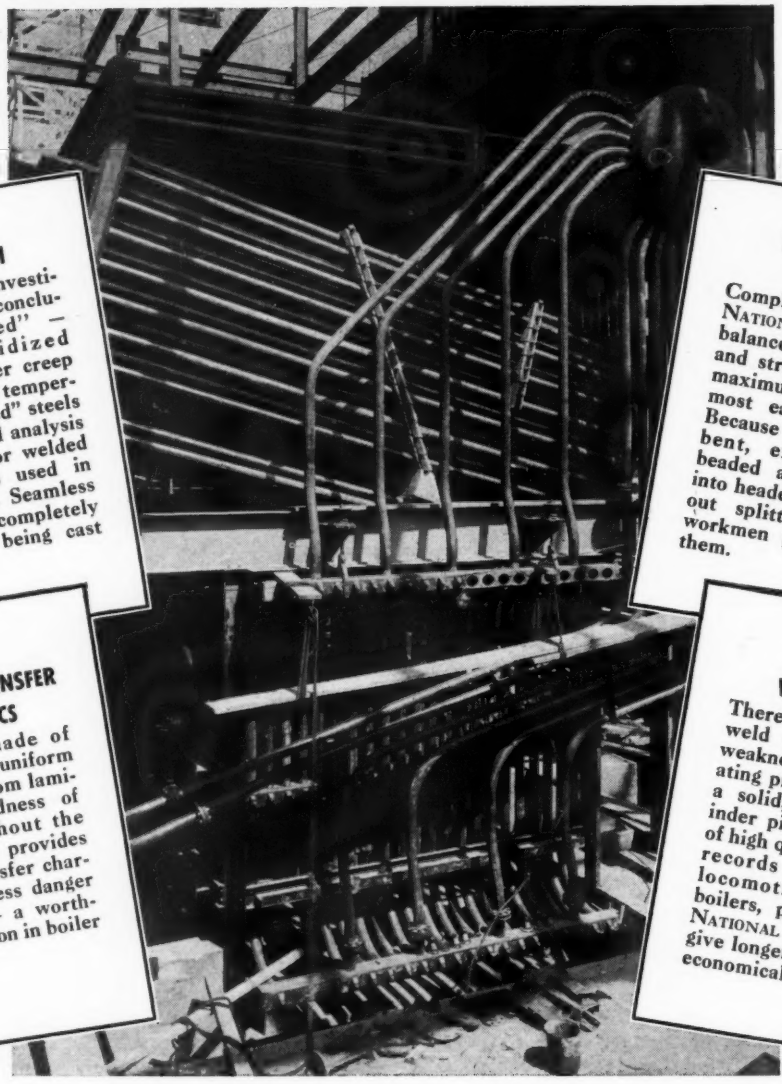
FAST'S *self-aligning* COUPLINGS

SEND FOR FREE CATALOG giving detailed descriptions, engineering drawings, dimension and capacity tables and typical installation photographs for the many types of Fast's Couplings. Fill out this coupon and mail it to: Koppers Co., Inc., Fast's Coupling Dept., 247 Scott St., Baltimore 3, Md.

Name..... Position.....

Company.....

Street..... City..... State.....



HIGHER CREEP STRENGTH

Tests by impartial investigators have shown conclusively that "killed" — thoroughly deoxidized steels — have better creep strength at elevated temperatures than "rimmed" steels of similar chemical analysis commonly used for welded tubes. *All* steels used in U·S·S NATIONAL Seamless Boiler Tubes are completely "killed" before being cast into ingots.

BETTER WORKING PROPERTIES

Complete annealing gives NATIONAL Tubes the right balance between ductility and strength which assures maximum service and utmost ease of installation. Because they can be readily bent, expanded, flared, beaded and rolled tightly into headers or sheets without splitting or fracture, workmen prefer to install them.

SUPERIOR HEAT TRANSFER CHARACTERISTICS

Seamless tubes made of "killed" steels have uniform density, freedom from laminations and soundness of structure throughout the metal walls. This provides superior heat transfer characteristics with less danger of "hot spots" — a worthwhile consideration in boiler tube service.

"WALLS WITHOUT WELDS"

There is no longitudinal weld or line of potential weakness to limit safe operating pressure. Each tube is a solid, homogeneous cylinder pierced from a billet of high quality steel. Service records from stationary, locomotive, and marine boilers, prove that U·S·S NATIONAL Seamless Tubes give longer, safer, and more economical service.

These 4 basic advantages PAY OFF

when you're handling extreme pressures, high temperatures or complicated assemblies

THAT'S why so many public utilities and other high pressure steam plants have standardized on U·S·S NATIONAL Seamless Boiler Tubes. To the Seamless Process of tube making —pioneered by NATIONAL—can be credited much of the advance made in more efficient steam production.

Piercing a tube from a solid billet of steel is the only process that absolutely removes all uncertainty regarding uniform wall strength—that provides the structural homogeneity and the assured safety, security, and dependability of a solid forging.

What is equally important, these superior "Walls Without Welds" have been continually improved, both in their metallurgy and in their fabrication, to insure lasting safety and economy under increasingly heavier loads.

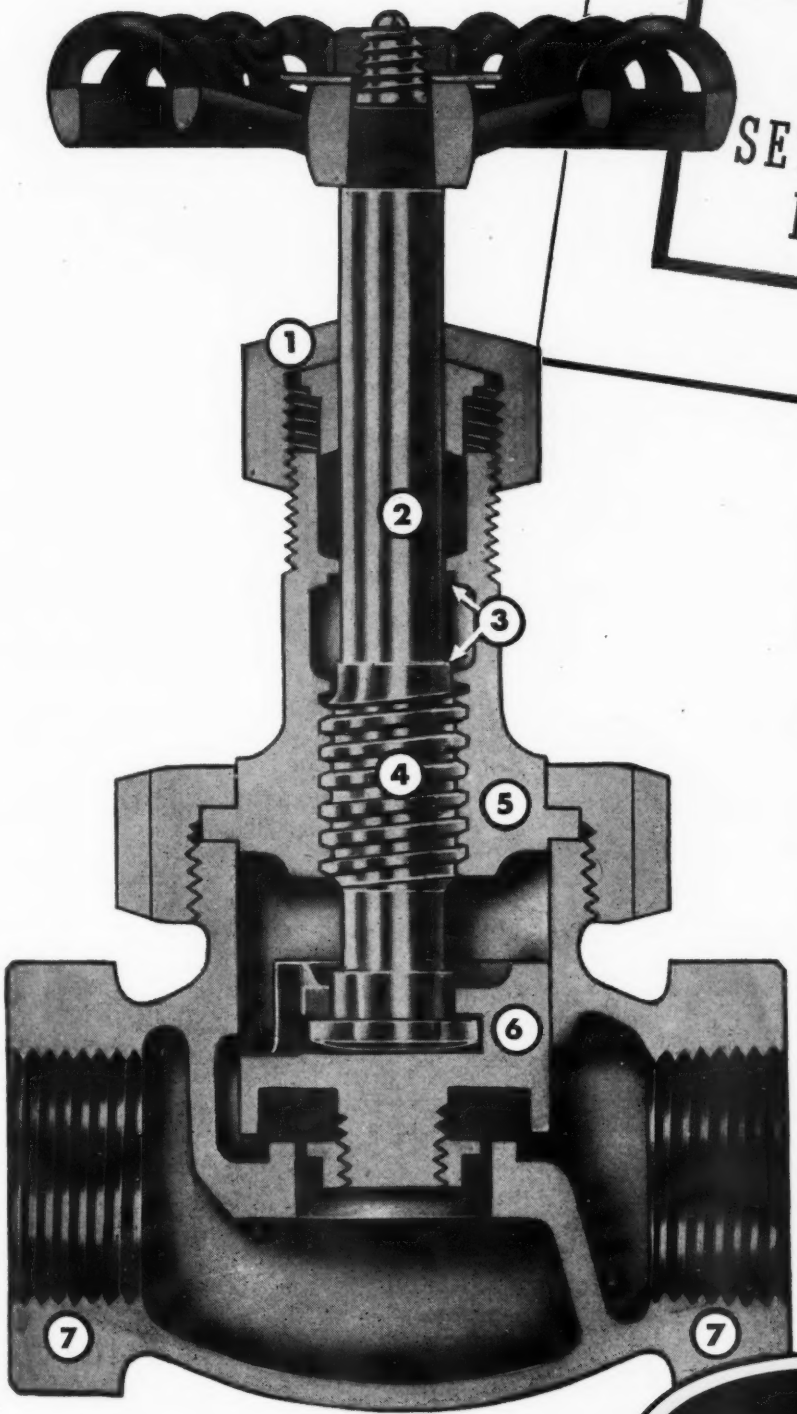
NATIONAL TUBE COMPANY, PITTSBURGH, PA.
(TUBING SPECIALTIES DIVISION)
COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

NATIONAL (WALLS WITHOUT WELDS) *Seamless*
BOILER TUBES

UNITED STATES STEEL

COST REDUCING *extras...*

OIC SETS THE PACE IN VALVES



1 The extra large packing nut will stand a man-sized wrench and has sufficient threads to utilize all packing in the stuffing box.

2 Heavy, wear-resisting manganese bronze stem means longer wear with less maintenance.

3 Back seating, providing special seat surface on stem above threads, permits quick, easy repacking under pressure.

4 Large thread contact area withstands extraordinary strain and maintains tight closure.

5 Sturdy bronze bonnet, union type construction, assures a tight bonnet joint and permits quicker and easier inspection and servicing.

6 Slip-on type disc holder is designed especially to permit quick, easy replacement.

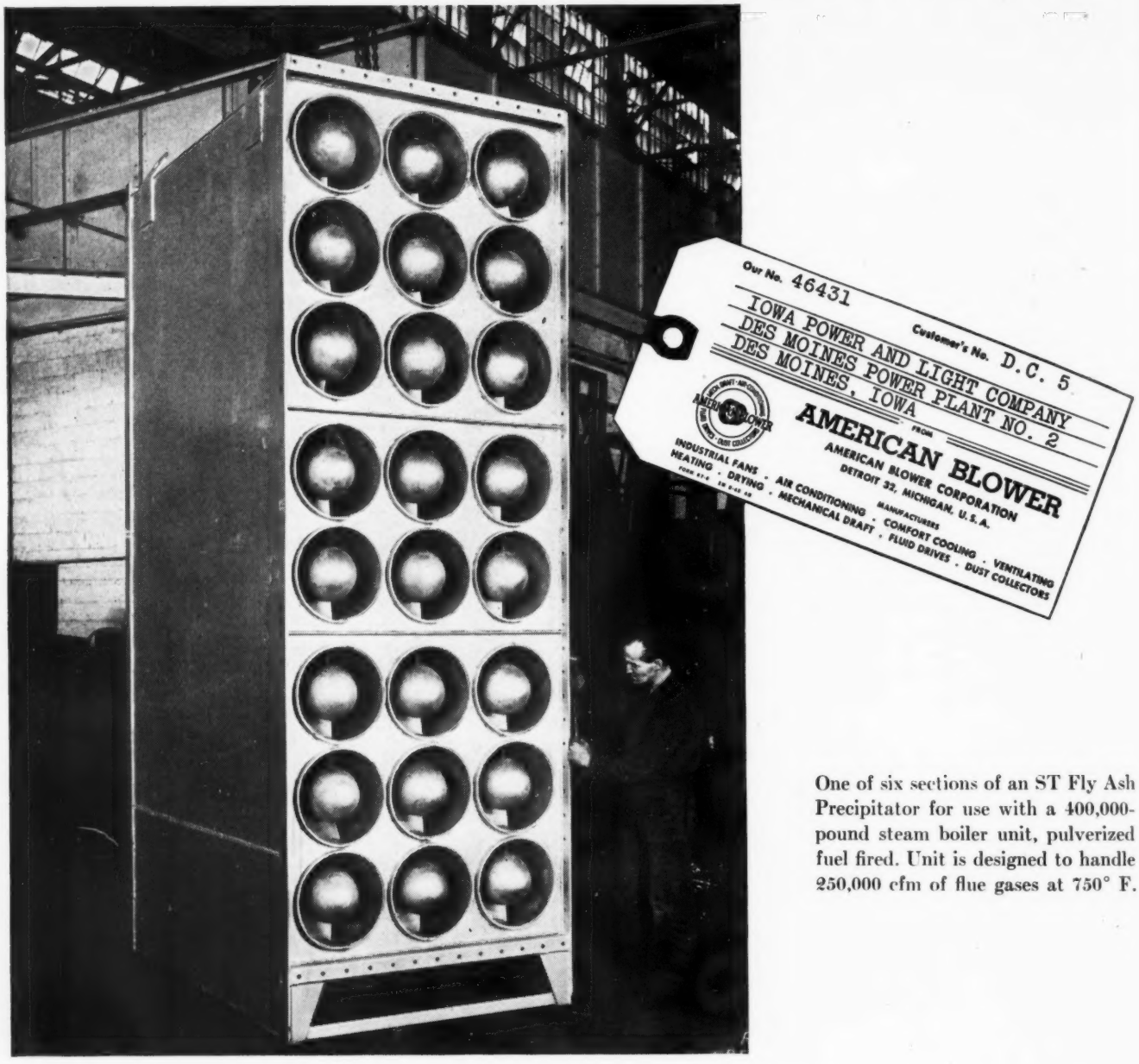
7 Heavier, better construction throughout the distortion-proof body provides maximum resistance to operating stresses. Full area water ways throughout. Adequate stock for repeated re-seating.

NO MORE CHANGE-OVER TROUBLES WITH THE HANDY OIC CROSS REFERENCE CHART
Just check the number of the valve that you wish to replace, look in the OIC Cross Reference Chart, and you will find the number of the OIC Valve to replace it. For your free copy, write to The Ohio Injector Company, Wadsworth, Ohio.

0-348-12

OIC VALVES

STEEL • IRON • BRONZE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DES MOINES POWER PLANT NO. 2
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DETROIT 32, MICHIGAN, U.S.A.
MANUFACTURERS
INDUSTRIAL FANS · HEATING · DRYING · AIR CONDITIONING · COMFORT COOLING · VENTILATING
MECHANICAL DRAFT · FLUID DRIVES · DUST COLLECTORS

One of six sections of an ST Fly Ash Precipitator for use with a 400,000-pound steam boiler unit, pulverized fuel fired. Unit is designed to handle 250,000 cfm of flue gases at 750° F.

from Detroit for Des Moines

When a famous producer of power reorders

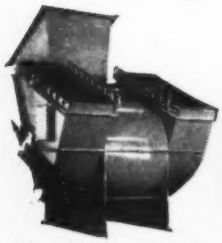
Fly Ash Collectors **Induced Draft Fans**
Forced Draft Fans **Gyrol Fluid Drives**

for an important new boiler unit, it's a sure sign of product satisfaction.

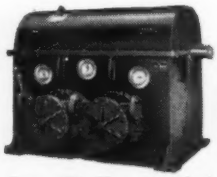
Yes! And it's further proof that American Blower Products maintain their popularity with old users while winning new users.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICH.
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.

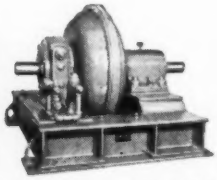
Division of American Radiator & Standard Sanitary corporation



HS and Sirocco Fans for forced or induced draft in all types of power plants.



Type VS Class 6 Gyrol Fluid Drive—for adjustable speed control of boiler feed pumps.

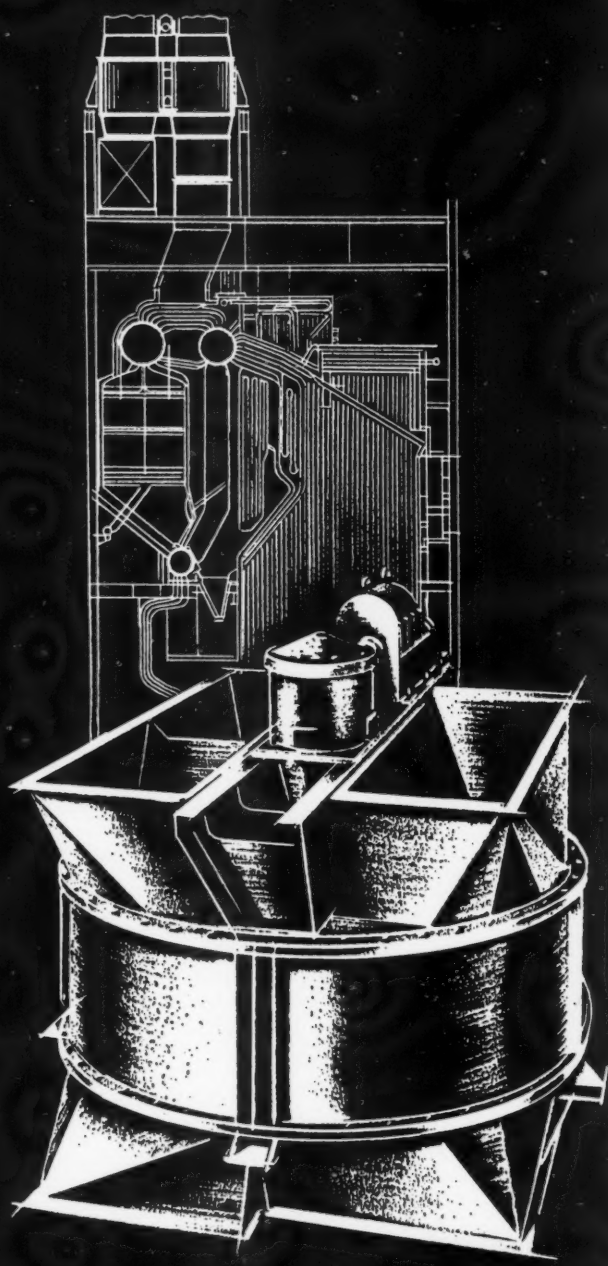


Type VS Gyrol Fluid Drive—for adjustable speed control of mechanical draft fans.

AMERICAN BLOWER

Designed for Preheat

when high-temperature air is essential



With the Ljungstrom Air Preheater, it is possible to supply high-temperature preheated air for combustion or processes.

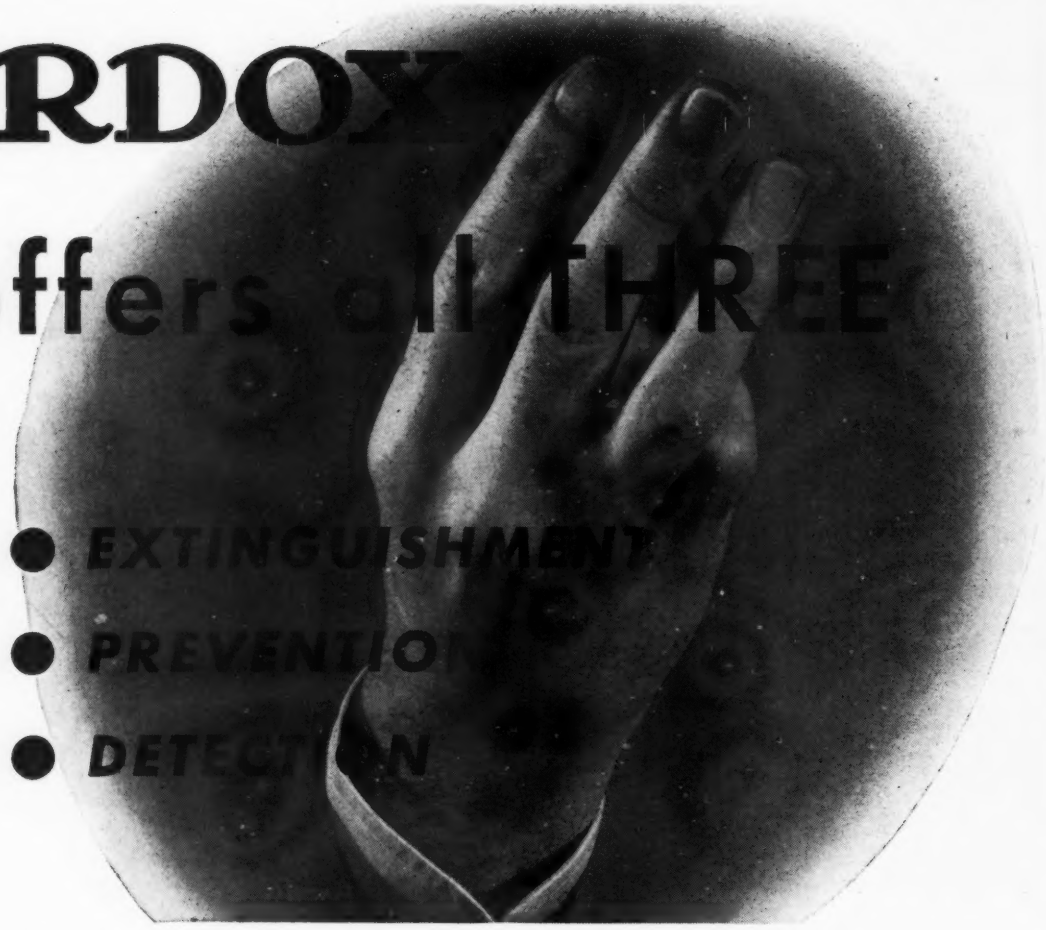
While plans for steam generation plants are under consideration investigate the possibilities of the Ljungstrom. The specialized experience of Air Preheater engineers is at your disposal, to aid you in effecting the most economic heat recovery from flue gases.

The Air Preheater Corporation

EXECUTIVE OFFICES: 60 East 42nd Street, New York 17, N. Y. • **PLANT:** Wellsville, N. Y.

CARDOX

offers all THREE



- EXTINGUISHMENT
- PREVENTION
- DETECTION

How thoroughly have you analyzed your fire problems?—and how recently? Are you fully informed in all that is new in methods and equipment for improved protection of every type of fire hazard? As a leader in all three vital phases of fire protection...*Extinguishment, Prevention,* and *Detection*...Cardox offers you practical cooperation in determining the most efficient method . . . or combination of methods . . . for guarding against staggering fire losses.

EXTINGUISHMENT

Cardox engineered applications of low-pressure carbon dioxide give this fast-acting, non-damaging extinguishing medium maximum effectiveness in conquering fires, large or small, both indoors and out. Cardox Fire Extinguishing Systems offer broadscale protection with centrally located, compactly designed storage units with capacities of 500 pounds to 125 tons of Cardox CO_2, and Mobile Units with capacities of 750 pounds to 3 tons.

Bulletin S-378

PREVENTION

Cardox Atmosphere Inerting Systems are available to provide inert gas for *continuous* fire and explosion prevention in the handling and storage of flammable liquids, chemicals, paints, varnishes, and solvents, or where other materials in storage present serious fire and explosion hazards. These systems also are used to provide an economical source of inert gas as part of continuous production processes.

Bulletin C-378

DETECTION

Cardox Detection Systems, actuated by heat, smoke or flame, give prompt warning of incipient fires. These systems, with detectors located throughout large establishments . . . may be used purely as a warning device, or may be engineered to actuate an extinguishing system.

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CARDOX

CO_2 FIRE EXTINGUISHING SYSTEMS

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Furnished in coil or ring form or on reels... for high or low pressures... temperatures to 200°F... size ⅜" square to 1½" square.

Examine the special construction of Ankorite 387-F as shown in cross-cut sectional view. You will see how the resilient core is bonded to the inner braids with a binder which makes the interior impervious to liquid pressures. This permits the soft outer braids to absorb a portion of the liquid and keep it in contact with the plunger or shaft surface, thus insuring liquid film lubrication at all times. Soft lead wires interspersed only in the outer braid, are sufficient to promote low friction contact and protect shaft or plunger surface.

SUGGESTED USES: Circulating Pumps... High Pressure Hydraulic Apparatus... Hydro-Turbine Shafts... Water Works Pumps... Ship Propeller Shafts... Ship Rudder Post... and wherever else Flax Packings are used. Write today for full details.

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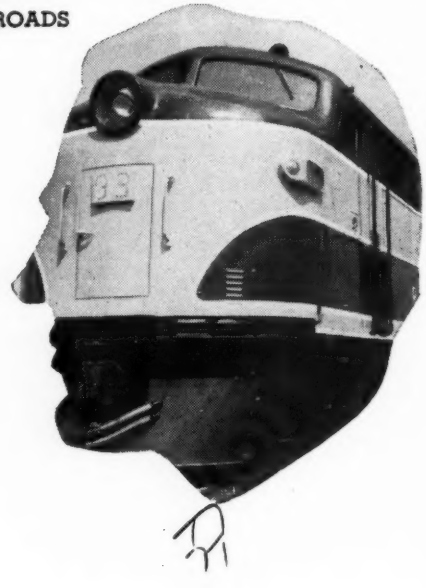

Rockbestos representatives are more than salesmen . . . they are seasoned, informed *Field Engineers.*

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Use the service he can give you. It doesn't obligate you . . . either in fact or in spirit. It's reliable. It's experienced. Use it.

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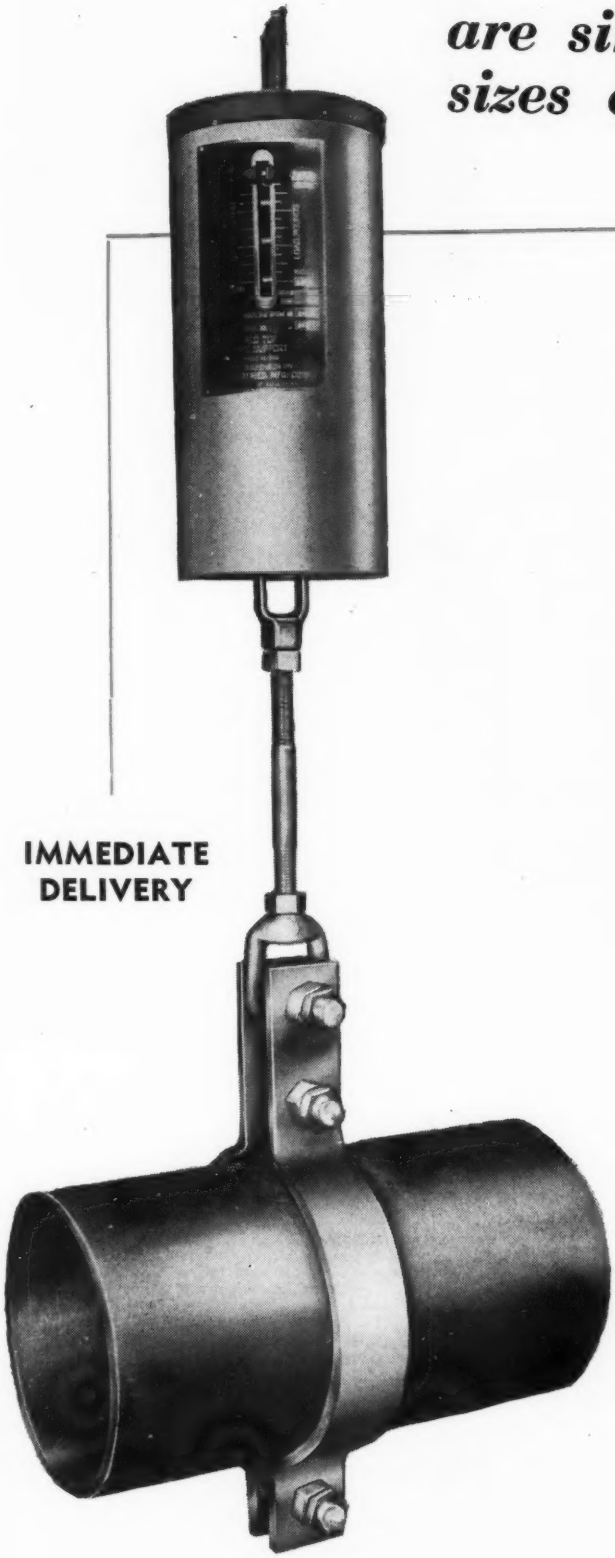
THE WIRE WITH PERMANENT INSULATION

RED TOP PIPE SUPPORTS

are simple to select—three sizes cover complete range



IMMEDIATE DELIVERY

One reason for prompt delivery of RED TOP Pipe Supports is the fact that they are stocked in three standard model sizes and that these sizes provide for supporting any load ranging from 100 to 5000 pounds. Total travel on all sizes is 3".

With only three sizes from which to choose, it is an easy matter with the aid of a simple table to select the proper model for the specific installation conditions. Furthermore, by standardizing on a few sizes, advantage can be taken of mass production economies, with resultant lower costs.

Design is modern and has been achieved by extensive research and development. RED TOP Pipe Supports are 'engineered' to meet the most exacting requirements of modern piping systems.

Further details are available on request.

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Send for Catalog No. 316

C. H. LEIBFRIED *Mfg. Corp.*

PIPE SUSPENSION DIVISION
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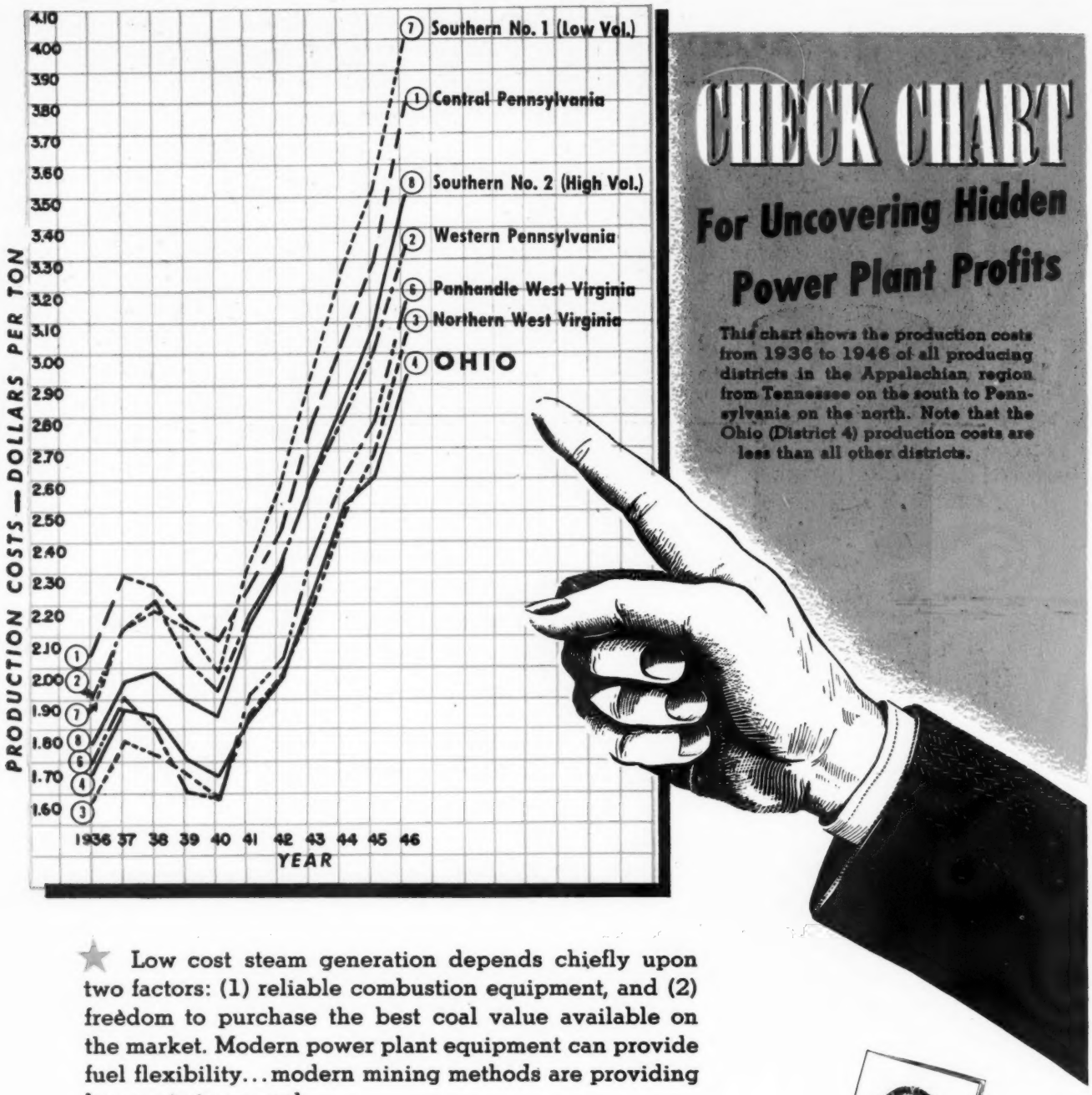

★ Low cost steam generation depends chiefly upon two factors: (1) reliable combustion equipment, and (2) freedom to purchase the best coal value available on the market. Modern power plant equipment can provide fuel flexibility... modern mining methods are providing low cost steam coal.

The above chart shows the variations in coal producing costs over a period of years. Such comparative cost figures are a helpful guide when forecasting the probable availability of low cost steam coal over the life of a plant. Then too, they often reveal a hidden source of power plant profits.

THIS BOOKLET contains charts, illustrations, diagrams and technical data on how to conduct a fuel investigation for lower power costs and other helpful information of interest to power plant designers, operators and owners. Free on request—write today.

OHIO COAL ASSOCIATION

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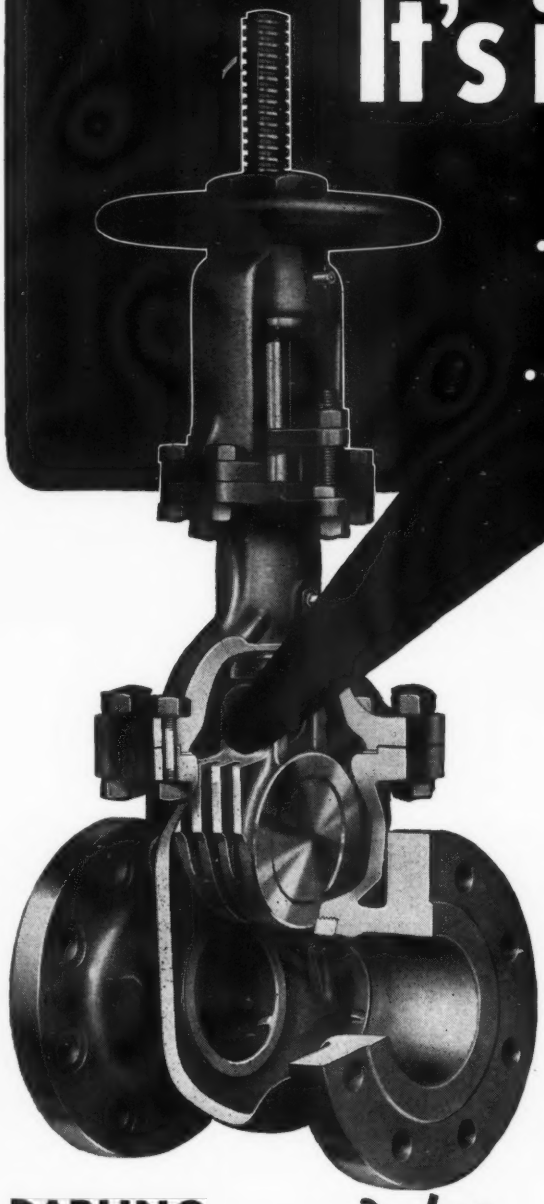
It's in the groove!

...less maintenance

...better performance



DARLING
Slotted Wedge
CAST STEEL GATE VALVES

SEEMINGLY small details of valve design can have a big effect on over-all valve performance . . . and on your pocketbook.

For example, look how the slotted wedge of this Darling cast steel gate valve is *double*-grooved, guided throughout its travel by corresponding twin ribs on each side of the valve body. This extra bearing area is a key factor in the perfect, lasting alignment of all parts. And, perfect alignment, together with the slotted wedge feature, makes it unnecessary to "reseat" the wedge at each closing and requires less force. Wedges and seats last longer, need less maintenance. Performance is more reliable. You save time and money.

Add several other equally effective Darling features and you'll see why Darling users swear by these rugged, trouble-free valves.

Wouldn't it be a good idea to get *complete* information? Simply specify your particular service requirements . . . or, send for the 300-page Darling Catalog No. 17M. It describes Darling Valves of *all* types and sizes . . . and is full of data of general value . . . yours for the asking.

Darling Gate Valves are made in a wide range of sizes, types and constructions for all kinds of normal and unusual service . . . and for pressures up to 3000 pounds. In addition to the slotted *wedge types, there are solid wedge taper seat valves and the famous Darling Fully Revolving Double Disc Parallel Seat Gate Valves for virtually any service.*

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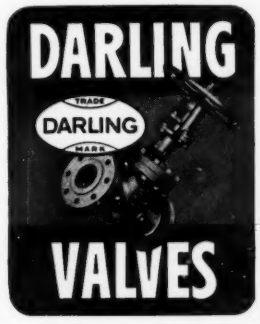

THE VALVE MARK OF QUALITY . . . WATCH FOR IT

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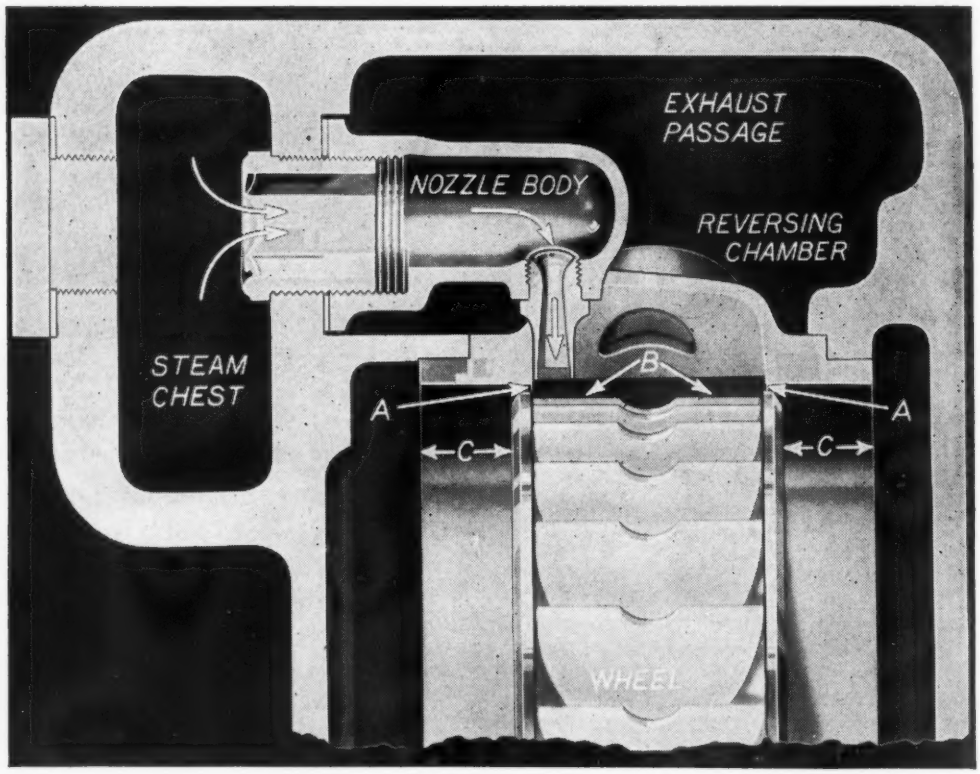

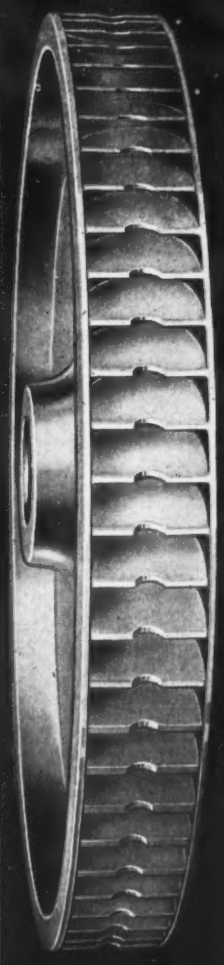

AMPLE CLEARANCES FOR DEPENDABILITY

Large blade and rim clearances and extra large side clearance — one inch — help make Terry One-piece Wheel Turbines highly dependable in operation.

The blades cannot foul because of the protection afforded by the rims, which are not damaged, should rubbing occur.

Note the rim clearance, AA in diagram. Also the large blade clearance, B. Side clearance, CC, is so large that end-play from external thrust cannot damage wheel.

Terry Bulletin S-116 will give you full information on the Terry Wheel Turbine. A request on your business letterhead will bring you a copy.

T-1171

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

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Yes . . . you can be sure of maintaining efficient working pressure longer when you use Hewitt Air Hose.

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You will, too. Just one look at this flexible, nonkinking hose and you'll see why Hewitt Air Hose withstands severe service.

If you could cut it apart you'd see an inner tube made of long-life rubber compounds to resist oil without swelling or flaking. You'd see a carcass of tightly twisted cord braids bonded with rubber compounds to assure high burst-resistance, without expansion and elongation.

And, of course, you'd notice that the tough cover is built for maximum protection against severe abrasion, impact, sun-checking, weathering.

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HEWITT OFFERS YOU THESE 3 TYPES OF AIR HOSE

1 Monarch. Molded and braided air hose used where hot oil conditions are especially severe. This is a top quality, highly flexible, yet nonkinking air hose built for most severe air tool and compressor service, where strongest and sturdiest in hose construction is needed.

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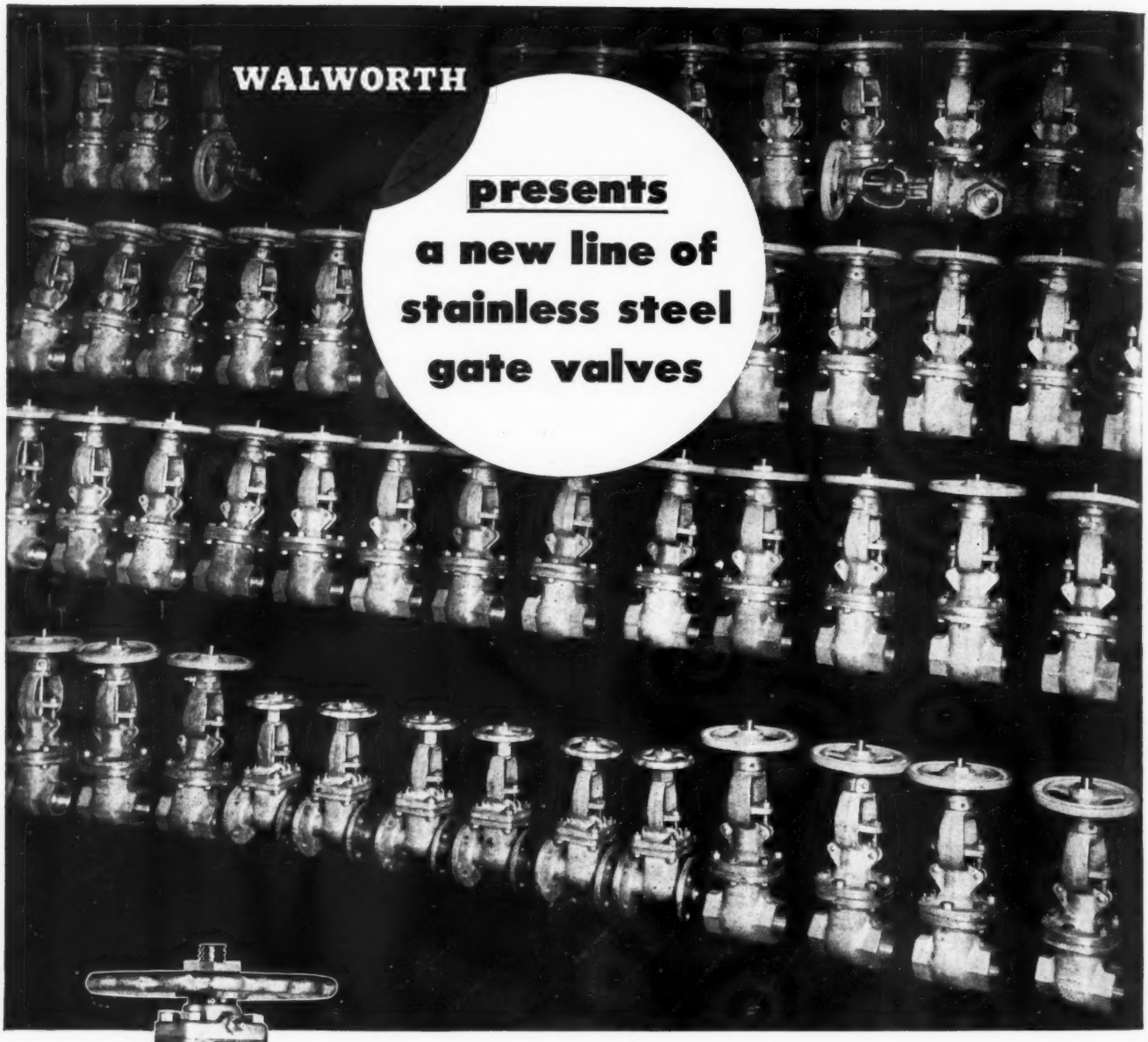
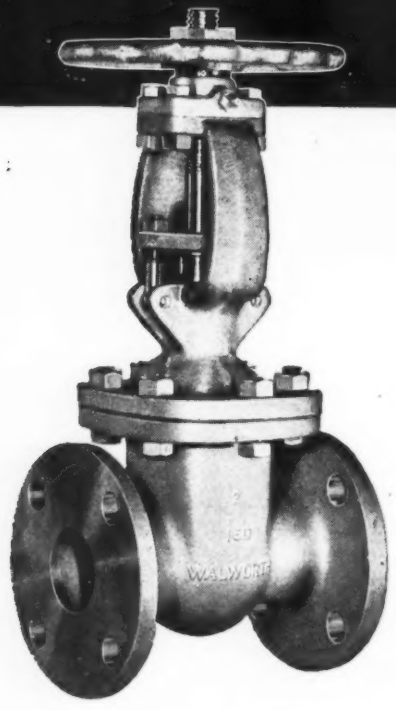
HEWITT RUBBER DIVISION, HEWITT-ROBINS INCORPORATED · MANUFACTURERS OF INDUSTRIAL HOSE • BELTING • PACKING





Walworth's *new* line of Stainless Steel Gate Valves is an excellent modern example of Walworth valve leadership. These valves combine the latest features of advanced valve design, with the traditional manufacturing skill which has made Walworth valves famous throughout the world.

See your Walworth distributor for further information on Walworth Stainless Steel Gate Valves, or Walworth's complete line of valves and fittings in other ferrous and non-ferrous metals.

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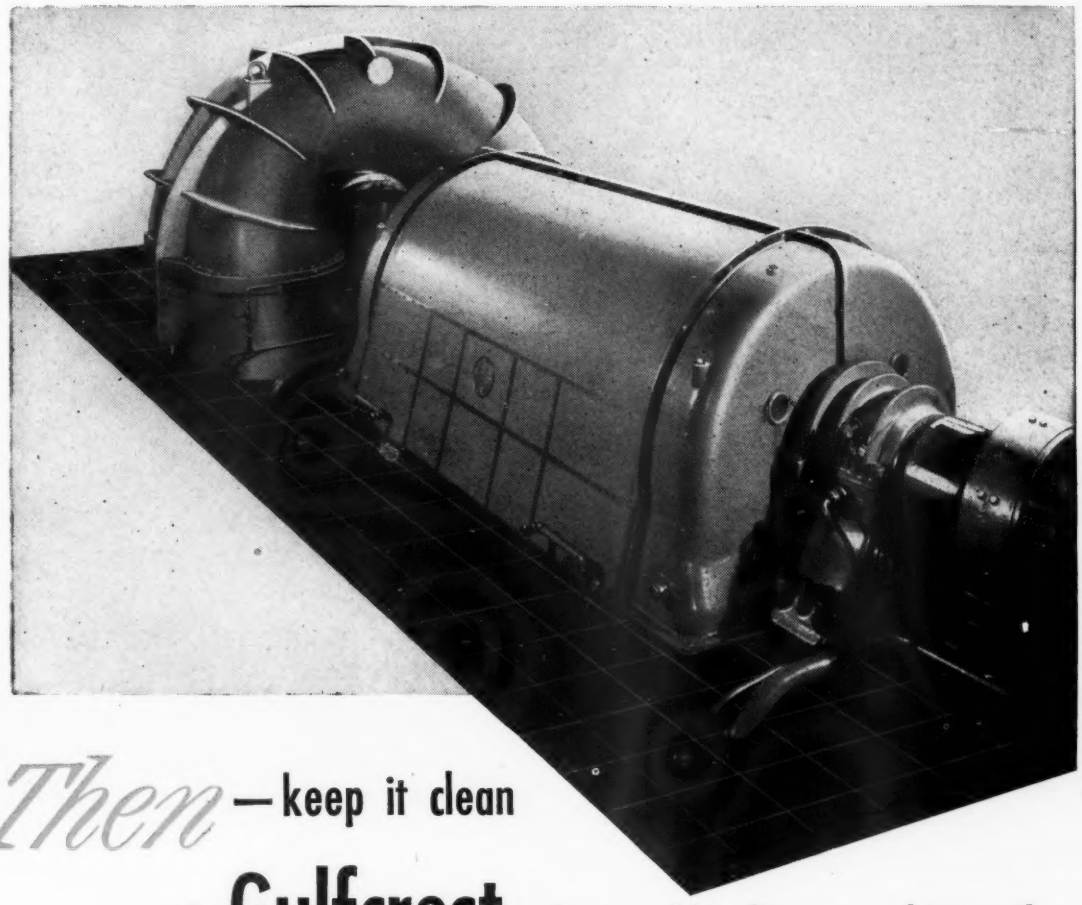
First — make sure the lubricating system is clean

with Gulf Turbine Flushing Oil

— ▶ *cleans effectively*
— ▶ *protects against rust*
— ▶ *does not affect lubricating qualities of turbine oil*



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BY taking these two steps, you can insure top lubricating efficiency down through the years for your new steam turbine.

The use of Gulf Turbine Flushing Oil—before the initial fill of lubricating oil — will remove grease type slushing compounds and carry away harmful abrasives which might be in the circulating system. Thus you make sure the system is clean—and avoid the possibility of trouble caused by contaminants.

For the finest lubrication — longer-lasting protection — it will pay you to investigate the advantages of Gulfcrest Oil WCR. Because of its outstanding resistance to oxidation—it's Alchlor-processed — Gulfcrest Oil WCR lasts indefinitely. With this quality oil and good operating practice, you can be sure there will be no sludge deposits in cooler tubes, bearing pedestals, or oil lines to worry about.

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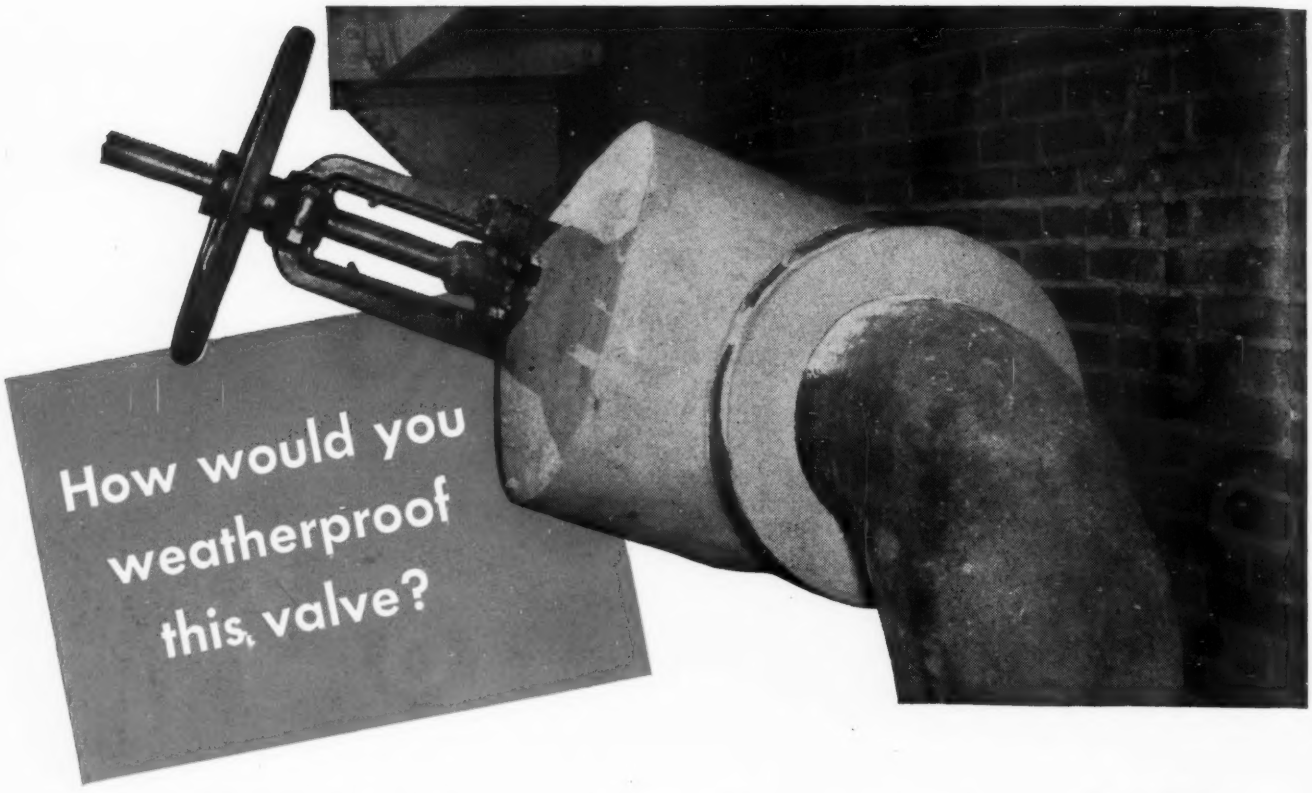
GULF INDUSTRIAL LUBRICATION



Valve on outdoor steam line 20' above ground is covered with 85% Magnesia. Note that valve body is very close to building wall. How would you protect the insulation on this valve from the weather?

A. Cover with light gauge galvanized metal accurately shaped to fit valve

B. Trowel on two one-eighth inch thick coats of weatherproof plastic

C. Wire roofing paper between valve and wall—cover the rest with plastic

HERE'S WHAT THE ARMSTRONG ENGINEER RECOMMENDED:

The best method of weatherproofing outdoor valves depends upon the location of the line and the service conditions involved. For outdoor lines that are exposed to bumping or abrasion, the additional protection of metal jackets is often worth the extra expense.

In the majority of cases, however, two coats of Armstrong's Insulmastic trowelled on over the asbestos cement finish will provide excellent protection against the weather. Insulmastic will not crack in cold or soften in heat. It is fire resistant, flexible, and smooth.

On the valve described above, there was not enough room between the insulation and the wall to make a perfect job of trowelled-on Insulmastic. The Armstrong engineer recommended that the insulation next to the wall be protected with roofing paper wired on. The more accessible parts were then weather-proofed with two coats of Armstrong's Insulmastic.

"Take nothing for granted" is an unwritten law with Armstrong engineers in estimating heat insulation jobs. Small details like the location of a valve in relation to a wall get careful scrutiny. If left to "mechanic's option," you'll find these details are done with equally conscientious skill by Armstrong's installation workmen.

On your next heat insulation job, call the nearest Armstrong district office for an estimate.

FREE INSULATION CHART

This chart lists types and thicknesses of insulation for temperatures from 300° below zero to 2800° F. Write for your copy to Armstrong Cork Co., Industrial Insulation Department, 7007 Maple Ave., Lancaster, Pennsylvania.

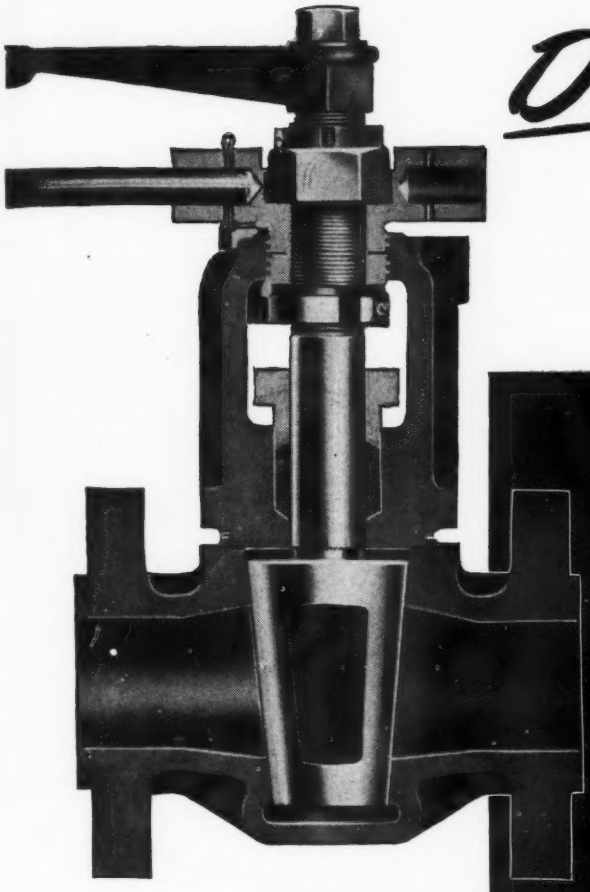
ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service For All Temperatures

From 300° Below Zero

To 2800° Fahrenheit

ELIMINATE VALVE FAILURES



Due to CORROSION
TEMPERATURE AND
PRESSURE EXTREMES

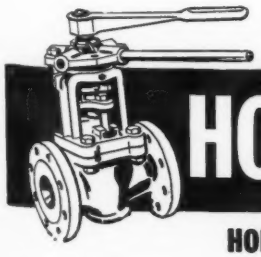
with HOMESTEAD LEVER-SEALD VALVES

They're Stick proof... Here's Why:

1. **INSTANT STICK-PROOF OPERATION.**
2. **Quarter-turn fully opens or closes.**
3. **Positive mechanical seal.**
4. **Seating surfaces always protected in both open and closed positions. Corrosion practically eliminated.**
5. **Unobstructed straight-line fluid flow.**
6. **All operating parts protected from damaging effects of service conditions and weather.**

Built into every valve is a *powerful lever-and-screw device* which relieves seating pressure between valve plug and body just enough to prevent friction and permit *easy turning at all times and under all conditions.* This exclusive LEVER-SEALD mechanism assures never-failing stick-proof operation no matter what the line contents are or how long the valve has remained in an open or closed position. Operation is positive even at temperatures as low as 40° below Zero or as high as 1120°Fahrenheit, at pressures from vacuum to 1500 pounds. The absolute reliability of HOMESTEAD LEVER-SEALD VALVE operation has kept them favorites for over 15 years, for difficult applications where temperature extremes, pressure and the corrosive action of line fluids render ordinary valves inoperative.

HOMESTEAD LEVER-SEALD VALVES are made in combinations of metals and alloys, such as stainless steel, Monel Metal, Ampco Metal. Ni-Resist, Durimet, etc., to meet your service requirements in sizes 1½" to 10". Write for complete details and Valve Reference Book No. 38.



HOMESTEAD LEVER-SEALD VALVES

HOMESTEAD VALVE MANUFACTURING CO. • P. O. BOX 210 CORAOPOLIS, PENNA.

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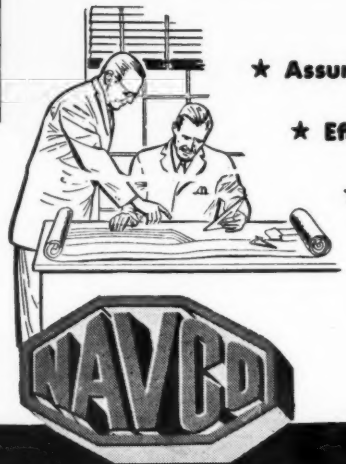

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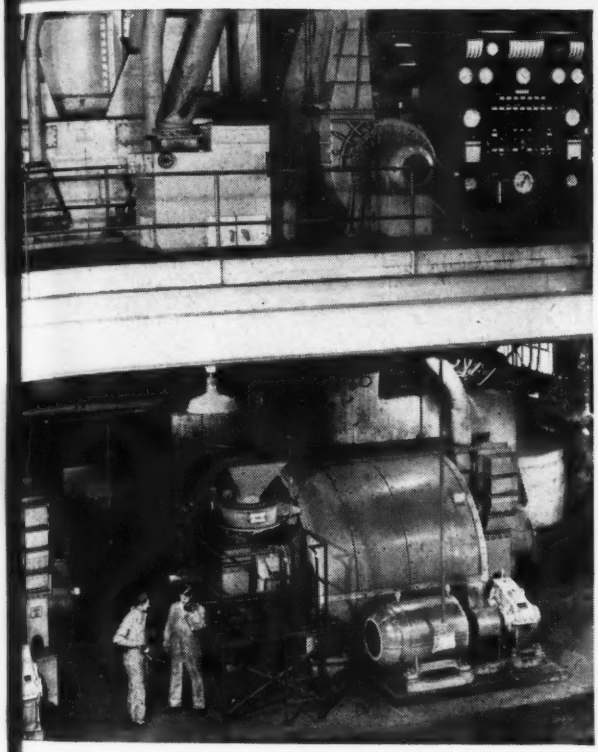
SPECIALISTS IN SCALE AND SLUDGE REMOVAL WITH CHEMICALS



How much POWER can Dowell Chemical Scale Removal Service Restore for you?

Power engineers have found in Dowell's *chemical* scale removal service a modern method for *restoring power*. They know that more efficient operation of boilers, condensers and other heat exchange equipment has been achieved after removal of the insulating scale and sludge deposits by this tested service. They have seen for themselves how effective Dowell's service really is.

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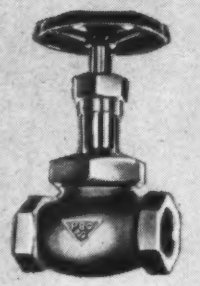

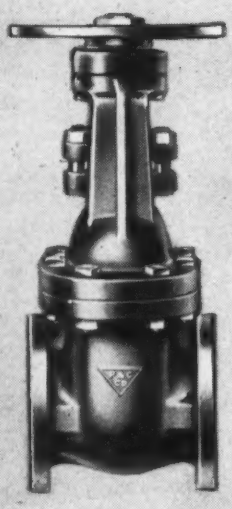

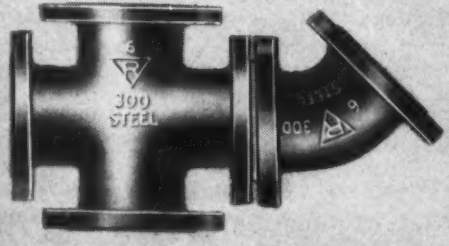

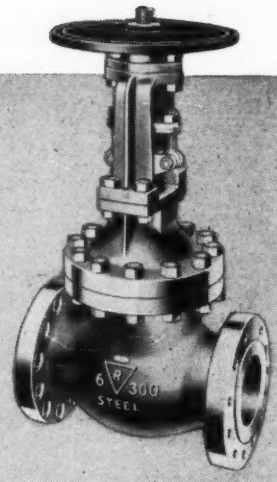

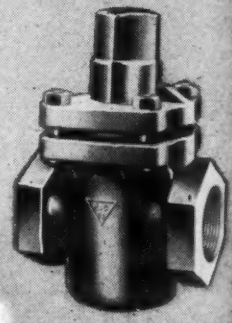

Men who really know valves—know where to look for those details of design and construction that insure top performance—have a lot of respect for Reading-Pratt & Cady.

An R-P & C valve must be more than just an assembly of machined parts. It has work to do. R-P & C feels the responsibility for that work being done faithfully.

Consider your R-P & C distributor as your "valve man"—a responsible source for bronze, iron and steel gate, globe, angle and check valves—Bar Stock valves—iron cocks—Lubrotite gate valves—cast steel fittings.

ACCO

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AMERICAN CHAIN & CABLE

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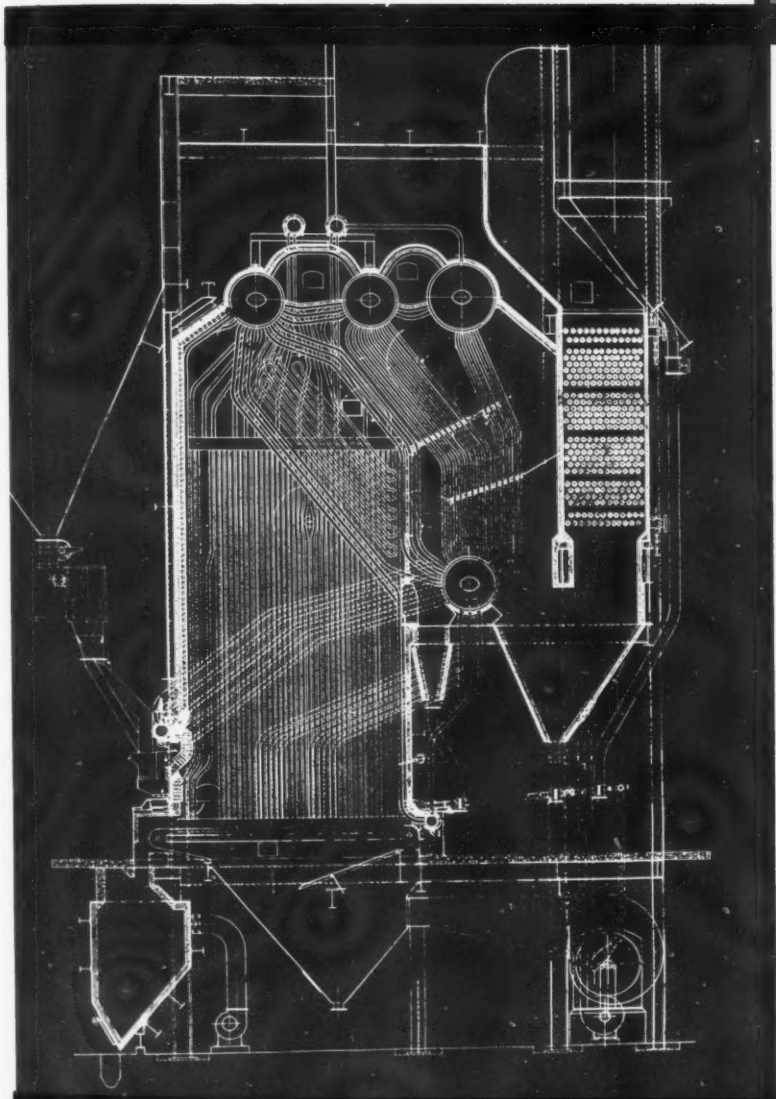
Another WICKES BOILER for Morton Salt Company



When engineers of the Morton Salt Company specified a Wickes 4-Drum Boiler for the Morton plant at Manistee, Michigan, their choice was dictated in part by proven Wickes performance. For this is the *second Wickes boiler* installed at Morton's Manistee plant—evidence that *Wickes design and construction delivers the efficiency* that industry demands of a power generating unit. Cummins & Barnard, Inc., Engineers, of Ann Arbor, Michigan were consulting engineers on this installation. Specifications include: 180,000# steam per hour capacity, design pressure 700 psi, and total temperature 750° F. The advantages of Wickes 4-Drum Boiler design are readily apparent. Large diameter drums, minimum number of tube bends, and steam liberating area large enough to insure *rapid response to load changes.* For boilers of any type with capacities up to 250,000 lb. steam per hour and 850 psi, *consult Wickes first.* We are completely equipped to design and build boilers to specific requirements.

THE WICKES BOILER CO.

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

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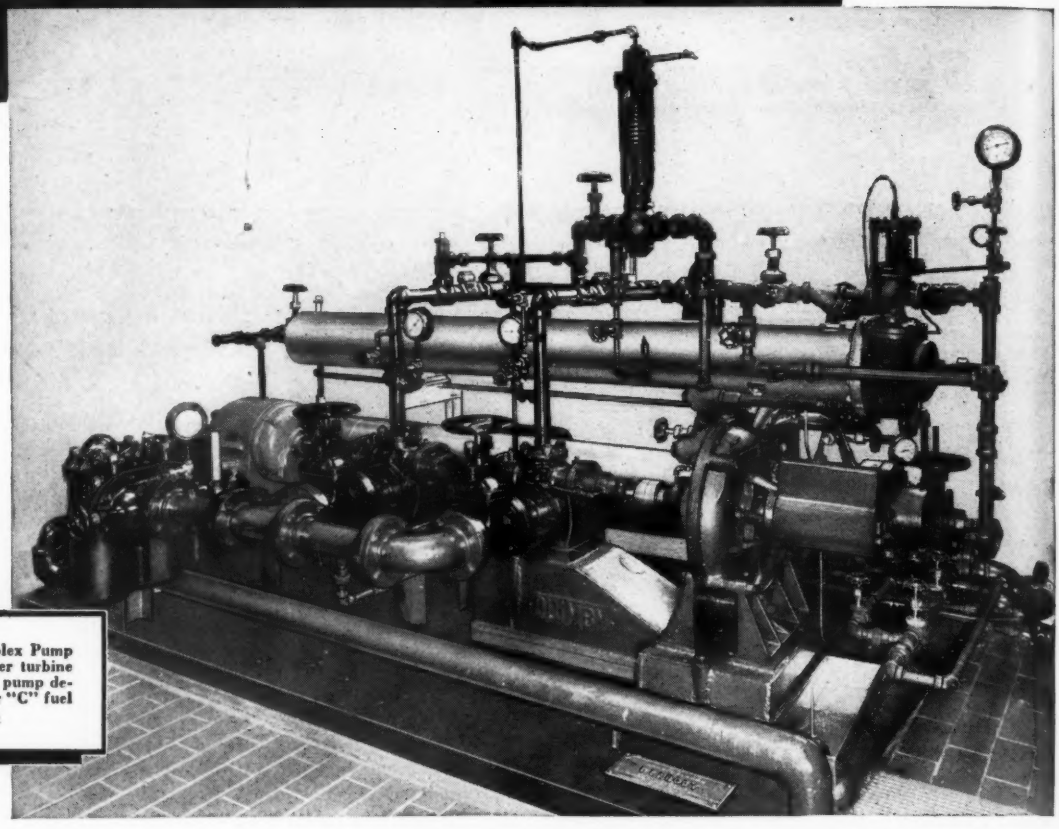
RECOGNIZED QUALITY SINCE 1854

DEPENDABLE, EFFICIENT and *Designed* FOR YOUR PLANT!



Typical Peabody Duplex Pump and Heater Set. Either turbine or motor driven screw pump delivers 12 GPM Bunker "C" fuel at 250 lbs. and 220°F.

. . . the completely automatic PEABODY FUEL OIL PUMP and HEATER SETS

Peabody Pump and Heater Sets, designed to burn Bunker "C" or other heavy fuels, are the result of more than 25 years of research and engineering in oil combustion efficiency. Compact, complete and built to last, Peabody units are always specified when plant overhead must be minimized and modernized to meet today's rising costs. Available in a wide capacity range, *for all types of burners.*

Here are only a few advantages you get in a Peabody installation:

Each set designed to specific requirements • Compact, complete unit mounted on common base • Quick, easy installation • Clean fuel delivered to burners at proper temperature and pressure • All parts available for inspection and maintenance • Easily cleaned, with no "down time" • Minimum space required • Factory-built and tested, delivered ready to receive your plant service connections • Low-mounted pumps, minimum suction lift

Complete details on request. Write for Bulletin 150.

PEABODY
ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 19, N. Y.
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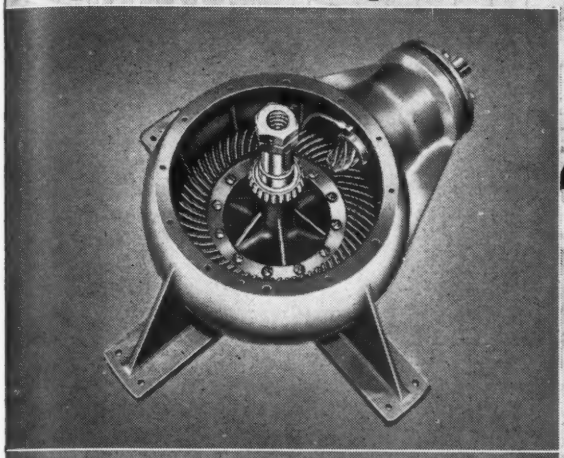
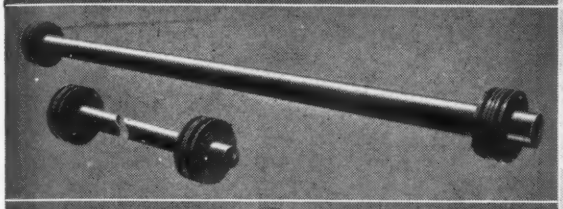
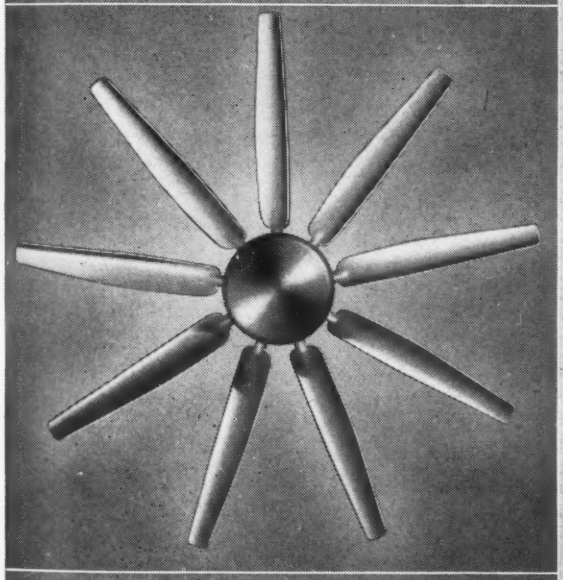
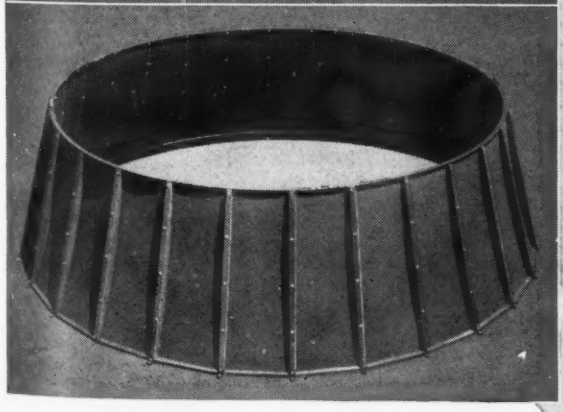
PHG

MARLEY MECHANICAL EQUIPMENT
Engineered Specifically for *Your*
Double-Flow
COOLING TOWERS









Mechanical equipment used on Double-Flow towers is Marley-designed for cooling tower service exclusively. Marley equipment is built to do just one job . . . move maximum volume of air with minimum horsepower and maintenance. Installations the world over prove the practical success of Marley designed equipment to do this job; do it better and more economically . . . And all Marley equipment is built in a range of sizes and materials to fit precisely the requirements of each application. Every Double-Flow installation is provided with the proper mechanical components to fulfill the guaranteed performance of that tower . . . and do it economically.

GEAREDUCERS—Designed for smooth power transmission over an extra long service life. "Upset" molychrome gears; tapered roller bearings; positive lubrication. Built in complete size range.

DRIVE SHAFTS and UNIVERSAL JOINTS—Shafts are of heavy tubular steel with steel yokes. Lengths for every fan diameter. Universals are flex discs—corrosion proof, need no lubrication; factory balanced and sized for the job.

FANS—Cast aluminum alloy in 6-, 9- and 12-blade models. All have adjustable pitch. Stainless steel fans are also available.

FAN CYLINDERS—Built of non-corrosive material and designed with venturi throat for minimum air entrance loss and turbulence. Sized to fan requirement; high enough for safety, low enough for inspection.

MARLEY COOLING TOWERS

THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

"packaged" coal-handling systems by G-W.

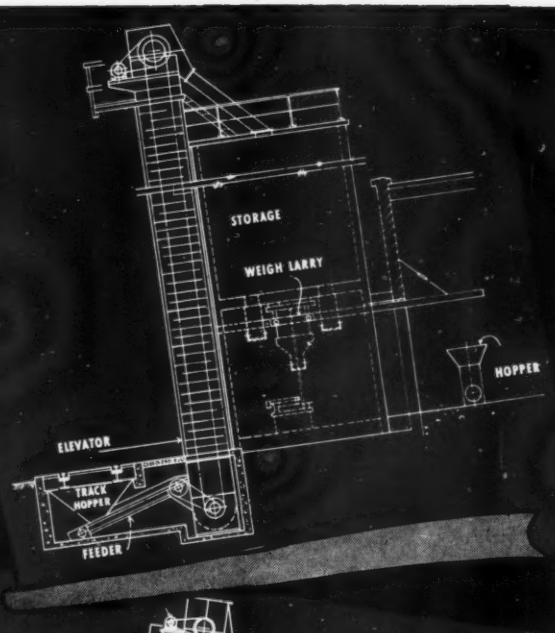
These three basic systems for handling coal (and/or ashes), designed by G-W, have been adapted to varying conditions in boiler plants.

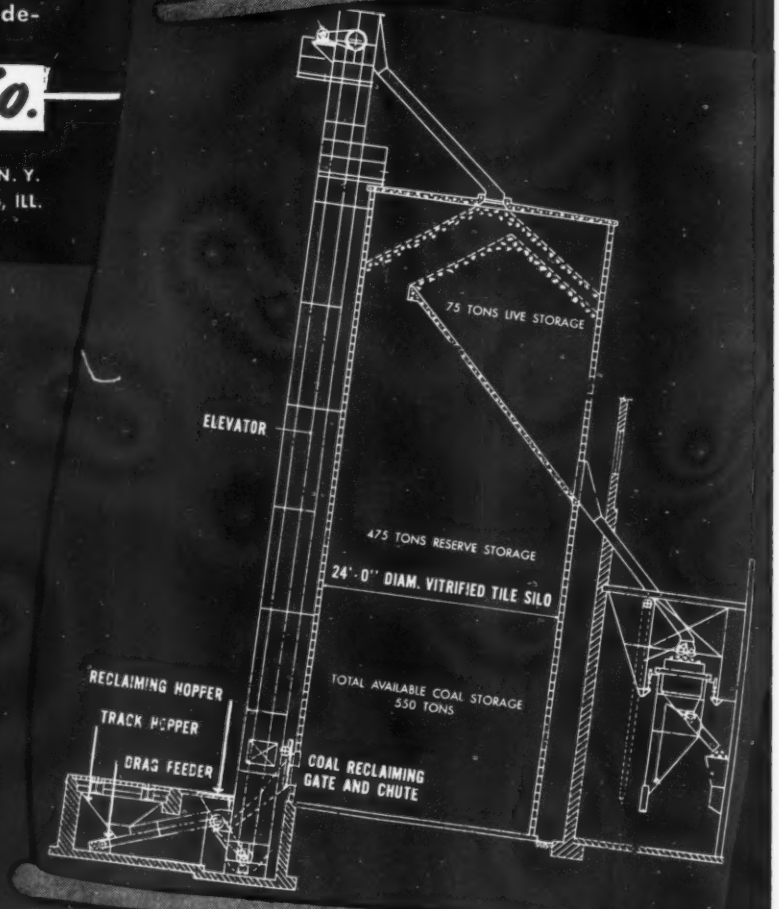
Let G-W do the entire job for you...design, manufacture, erection . . . shoulder all details . . . assume all responsibilities.

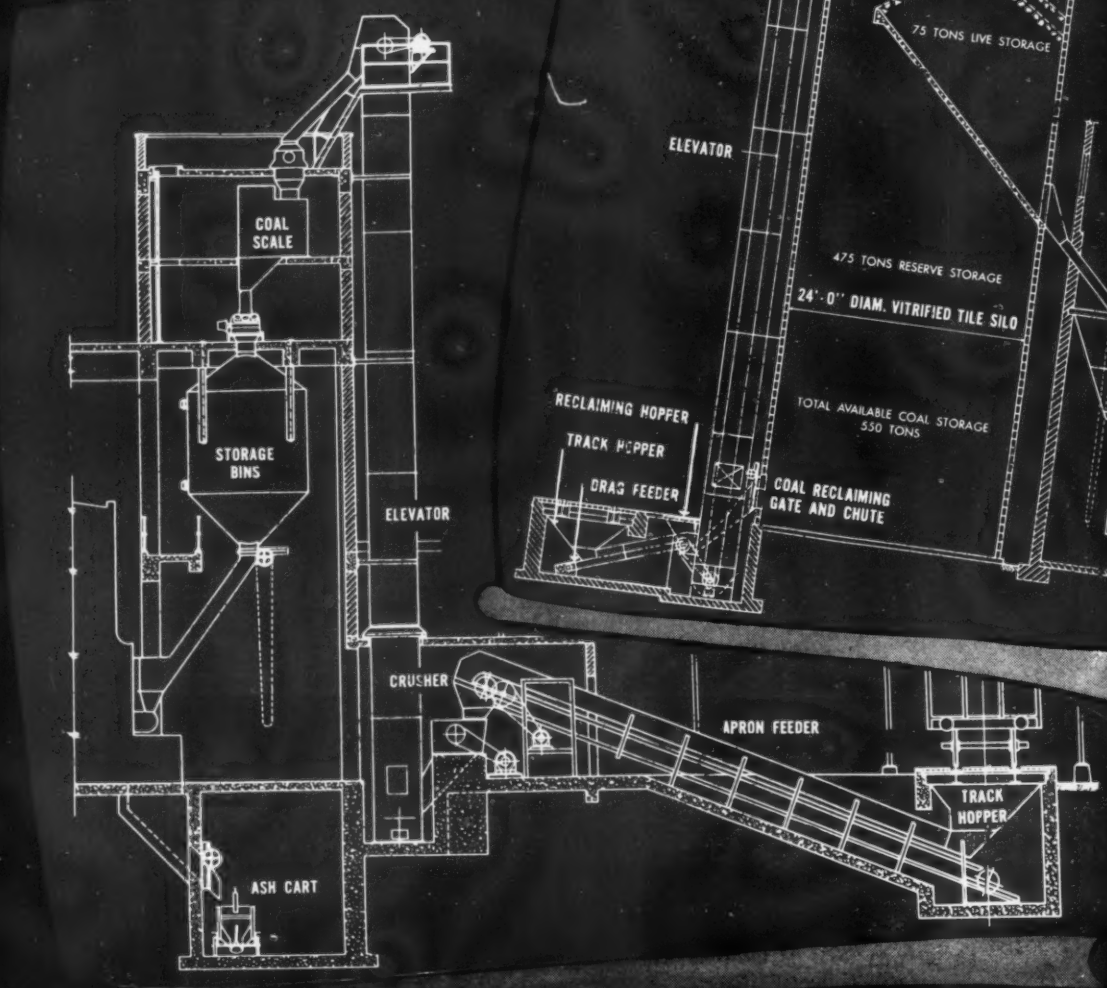
GIFFORD-WOOD CO.

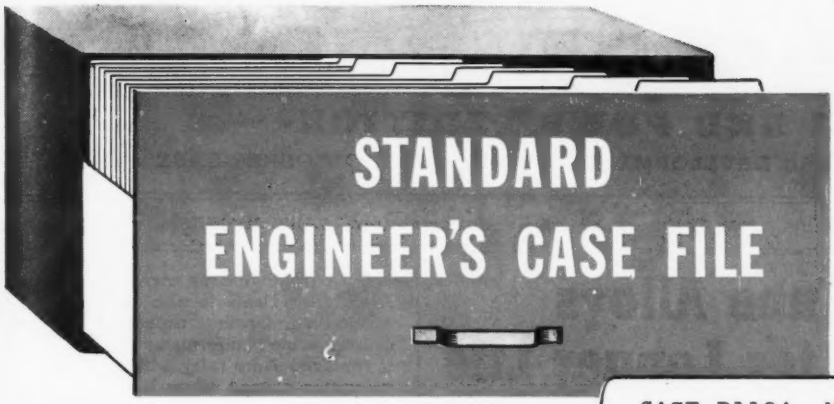
Since 1814

420 LEXINGTON AVENUE • NEW YORK 17, N. Y.
565 W. WASHINGTON STREET • CHICAGO 6, ILL.
Factory—Hudson, N. Y.

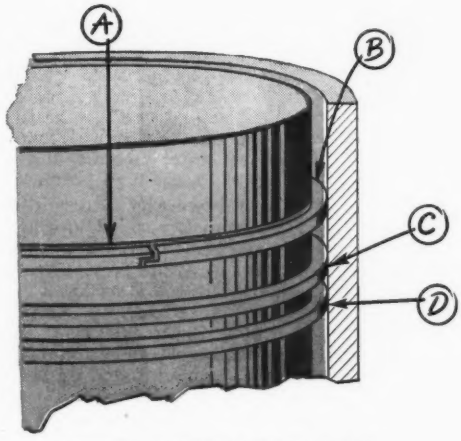








CASE D119A--MAINTAINING FULL POWER IN DIESEL ENGINES.



SECTION OF DIESEL ENGINE PISTON

Operators of Diesels in all types of service report RPM DELO Diesel Engine Lubricating Oil materially reduces power loss in three ways:

A. Detergent compounds prevent ring-sticking, allow full ring tension against cylinder wall, and this minimizes compression loss.

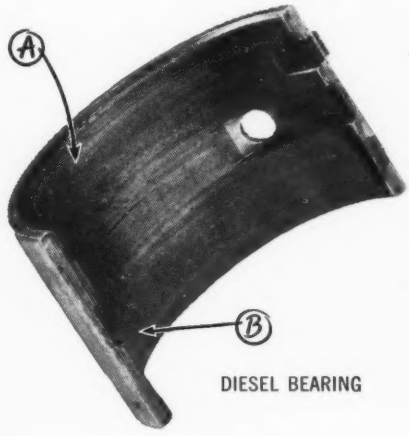
B. Metal-adhesion additive keeps full oil film on hot upper cylinder walls. These danger areas are often left unprotected by many oils.

C. RPM DELO Oil maintains a tough oil seal that stops blow-by of combustion gases.

D. An anti-oxidant increases the inherent stability of RPM DELO Oil's selected base stocks and resists lacquer formations on liners and piston skirts.

Other additives in this pioneer compounded oil prevent foaming, and control gum formations.

CASE D119B--PREVENTING FREQUENT BEARING REPLACEMENT DUE TO CORROSION.



DIESEL BEARING

In normal operation, Diesel engines require excess oxygen and operate at high temperatures. Under these conditions many unstable lubricants tend to turn corrosive and attack the lead in the copper-lead structure of alloy bearings. RPM DELO Diesel Engine Lubricating Oil is especially compounded to prevent this cause of bearing failure.

A. Selected base stocks are used that are naturally resistant to oxidation, the cause of most bearing corrosion.

B. Anti-oxidation compounds in RPM DELO Oil further reduce the danger of corrosion.

In laboratory corrosion tests, copper-lead bearing strips immersed in RPM DELO Diesel Engine Lubricating Oil showed considerably less weight loss than those protected by similar type oils.

For additional information and the name of your nearest Distributor, write

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COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

Better Condenser Tube Alloys ...for Longer Life

A survey of comparatively recent condenser tubing installations in power plants throughout the country indicates a definite trend towards the use of better, more corrosion-resistant alloys. It was found that slightly more than half of the installations specified Admiralty tubing with or without dezincification inhibitors such as arsenic, etc. This represents a considerable reduction in percentage over the years, since Admiralty condenser tubing once was the first choice for all power and marine installations using salt water or polluted fresh water. The remaining plants were divided among Aluminum Brass, Copper, Muntz, and Aluminum Bronze.

Muntz metal, which generally was chosen when conditions did not warrant Admiralty, has fallen to a low of about 5%. On the other hand, copper for good, clean fresh water conditions has evidently increased, since the installations of copper are two to one as compared to Muntz. The majority of seaboard installations preferred Aluminum Brass. This survey also indicated that Aluminum Bronze is gaining, with installations reported on both the Atlantic and Pacific coasts.

Lower Maintenance and Longer Life

It is evident that engineers are seeking to extend condenser tube life by the use of more corrosion-resistant alloys. Although these are higher in first cost, they soon pay for themselves in longer service life and lower maintenance. It is interesting to note that the trend towards the use of better materials has affected all industries, including building construction.

Condenser and heat exchanger tubes fall into the class of *essential tools for creating power.* Good tools are more economical in the end. With today's high installation and maintenance costs, which have probably doubled in some cases, it is considered sound economy to obtain the best, even if the first cost is high, and save through reduced maintenance and longer service life before replacement. The use of better materials has paid off in more ways than one. Equipment is often required to operate for long periods at maximum operating rates. Losses through shut-downs are considered costly and should be reduced to a minimum.

Using Better Alloys for Fresh Water

The general practice was for inland power plants to use Muntz metal unless corrosion conditions were very severe. The present use of Admiralty in places where Muntz was formerly specified is a step in the right direction. The difference in price between these alloys is small. On the other hand, Admiralty is a sort of insurance against the future when the water will probably become more corrosive because of increased pollution from industrial wastes and sewage. Arsenical Admiralty costs no more than plain Admiralty and should generally be specified in place of the latter, because it is more resistant to dezincification.

Under certain fresh water conditions Arsenical Copper has given excellent service and is finding wider application. It has replaced Muntz in some cases.

For Seaboard Stations and Marine Use

Aluminum Brass condenser tubing is replacing Admiralty in some power plant installations on the seaboard. Arsenical Aluminum Brass (Cuzinal) resists dezincification better than plain Aluminum Brass, and is also superior to Admiralty against impingement corrosion. Arsenical Aluminum Brass is also widely used in marine condensers, especially for merchant marine and for passenger ships. Here it replaced Admiralty when higher water velocities caused impingement corrosion of Admiralty.

Cupro Nickel (70-30) is specified by the U. S. Navy for fighting ships because dependability is of the first importance. In former days the Navy had standardized on Admiralty. Cupro Nickel is finding increased use in the main condensers of seaboard power plants where clean seawater is available. A number of Cupro Nickel installations have been made since the war ended. Cupro Nickel is excellent for feed water heaters and evaporators operating under high temperatures.

It is interesting to note that Arsenical Aluminum Bronze (Duronze IV) is now being specified for many seaboard installations. In actual service test, under certain conditions Duronze IV has proved superior to Admiralty, Aluminum Brass, and even Cupro Nickel. It stands up exceptionally well in polluted harbor waters that are contaminated by sewage and industrial wastes. This alloy gave a remarkable account of itself when it was first made, some years back, as an experimental mixture. Although Duronze IV is now a standard alloy with Bridgeport, it was not obtainable in quantity until about ten years ago. Engineers who are troubled by excessive corrosion from harbor water or estuaries should consult Bridgeport with the object of trying out test installations for observations under actual operating conditions.

Bridgeport's Laboratory should be consulted on all corrosion problems involving tubing for heat exchangers, feed water heaters, water coolers, refrigeration and other equipment where copper-base alloy tubing is used to cut down corrosion losses. Write for Bridgeport's Condenser Tube Manual on your company stationery and contact our nearest branch office for service.

CUPRO NICKEL (70-30)

Copper . . . 68.85%
Nickel . . . 30.00%
Iron 40%
Manganese . .75%

ALUMINUM BRONZE Duronze IV*

Copper . . . 94.25%
Aluminum . . 5.5%
Arsenic 25%
*U. S. Pat. No. 2,093,380

ALUMINUM BRASS

Copper . . . 77.0%
Aluminum . 2.0%
Arsenic 02%
Zinc . . . . Remainder

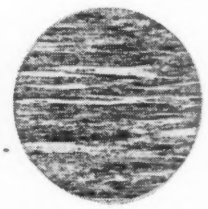
ARSENICAL ADMIRALTY

Copper . . . 71.0%
Tin 1.0%
Arsenic 03%
Zinc . . . . Remainder
Uninhibited Admiralty also available

ARSENICAL MUNTZ**

Copper . . . 62.0%
Arsenic . . . 0.1%
Zinc . . . . Remainder
**U. S. Pat. No. 2,118,688
Uninhibited Muntz also available

ARSENICAL COPPER



Arsenic
0.15% to 0.50%
Phosphorus . .025%
Copper . . Remainder

All Microstructures Mag. 75X

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • *ESTABLISHED 1865*

Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal

NOW!

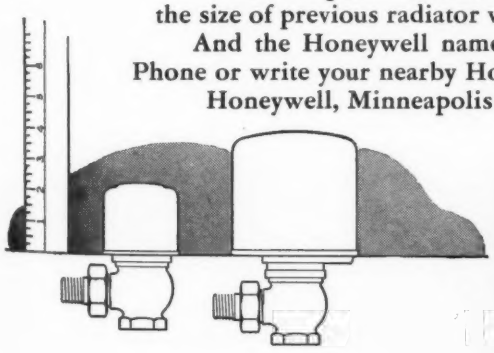
ONE FOURTH SIZE ....but EQUAL CAPACITY

the *NEW* Honeywell Full Modulating Radiator Valve

So small it mounts easily within convectors, you'll want to switch at once to the new Honeywell V0501 radiator valve.

You get not only a trim, inconspicuous valve adaptable to small spaces, but improved performance as well. This new "half-pint," with capacity for all normal pressures, is fully modulating—seeks any position as required—and is available with a full range of port sizes to fit all radiation capacities. Design improvements eliminate frequent adjustments and include such practical features as tamper-proof cover and packing replacement without system shut-down.

Most important, remember that a truly small valve is now available—just *one-fourth* the size of previous radiator valves—an engineering achievement of which we are proud. And the Honeywell name is your assurance of long-lived, dependable performance. Phone or write your nearby Honeywell branch today for complete specifications. Minneapolis-Honeywell, Minneapolis 8, Minnesota. In Canada: Leaside, Toronto 17, Ontario.



MINNEAPOLIS Honeywell CONTROL SYSTEMS

FLOAT Your Coal in Air for Complete Combustion

with

STRONG-SCOTT UNIT PULVERIZER

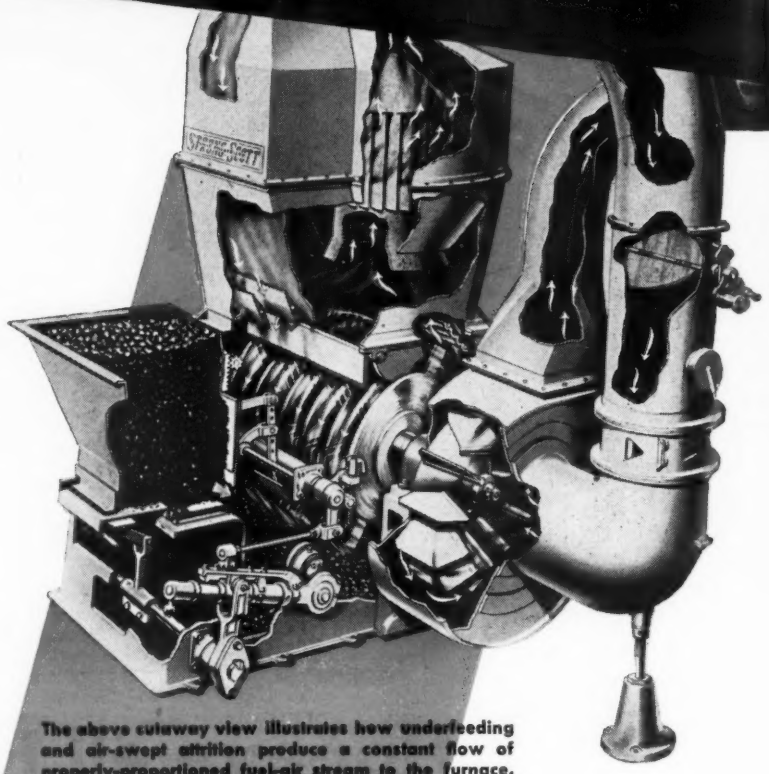
If you want *more* steam per pound of coal, maximum combustion efficiency with less smoke, then pulverize your coal with the STRONG-SCOTT underfed Unit Pulverizer . . . in which air-swept attrition does the work. It soon pays for itself with increased combustion efficiency.

Complete combustion is achieved only when the combustion-air is properly mixed with the fine coal particles.

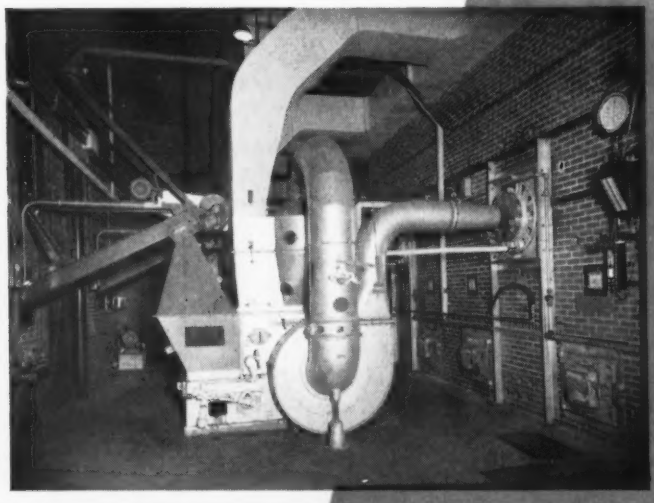
STRONG-SCOTT dries, pulverizes, and delivers coal to the furnace in suspension —all in one operation; with one motor.

Other Advantages

- ***Pulverizes ANY bituminous coal or by-product pitch.*** Dries wet or frozen coal faster because it handles 4 to 5 times as much preheated air as any other pulverizer.
- ***Simple to operate.*** Has foolproof automatic regulation of fuel feeding, air supply and fuel-air mixture.
- ***Easy maintenance.*** Wide clearance in grinding chamber prevents damage from oversize lumps, tramp iron, rock, pyrites, etc.
- ***Rugged construction.*** Simple, rugged design guarantees years of dependable service. Some units have been in continuous service for 20 years.



The above cutaway view illustrates how underfeeding and air-swept attrition produce a constant flow of properly-proportioned fuel-air stream to the furnace, for complete and continuous combustion.



HERE are three reasons why STRONG-SCOTT Unit Pulverizers do a better job:

1. **Simple design and rugged construction.**
2. **Flexibility and adaptability to varying local conditions and fuels.**
3. **General dependability of operation.**

Every STRONG-SCOTT installation is backed by 51 years of manufacturing experience—24 in the combustion engineering field.

WRITE TODAY for Bulletin 341 for complete information. ***Names of users in your vicinity furnished on request.***

The STRONG-SCOTT Mfg. Co.
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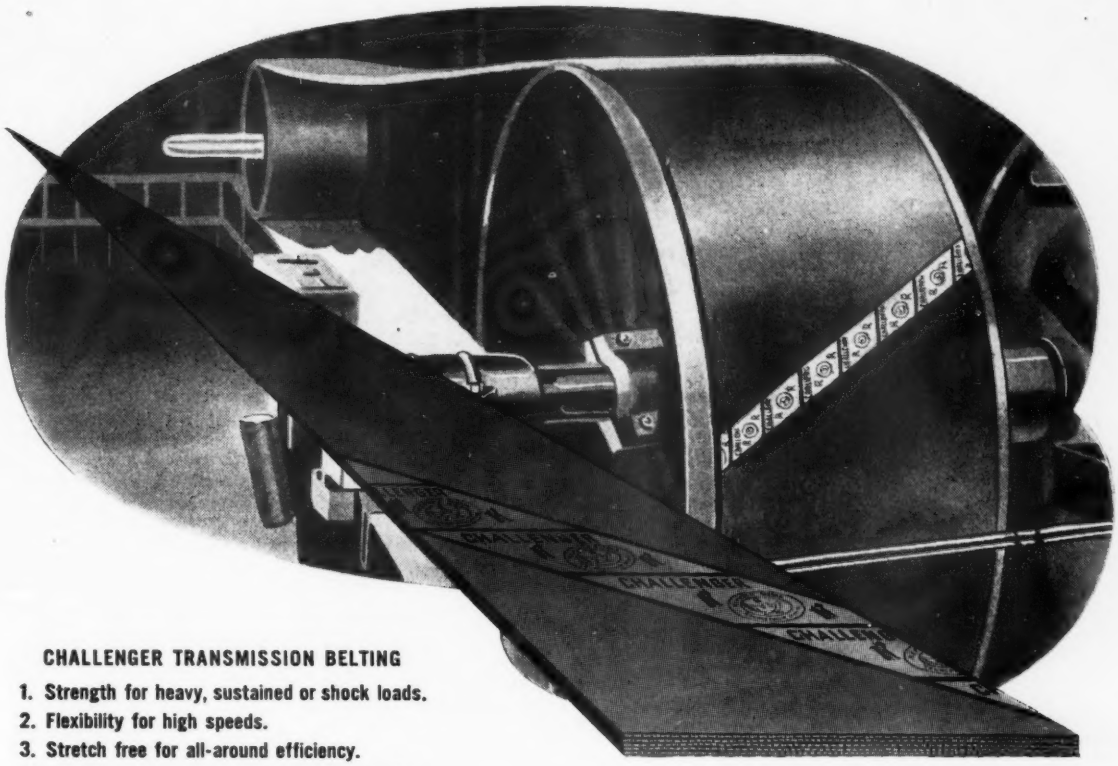
STRONG-SCOTT
UNIT PULVERIZER

A Distributor serves you Best



CHALLENGER TRANSMISSION BELTING

1. Strength for heavy, sustained or shock loads.
2. Flexibility for high speeds.
3. Stretch free for all-around efficiency.
4. Friction surfaces for maximum pulley traction.

HOW A REPUBLIC RUBBER DISTRIBUTOR SERVES AS A FACTORY DEPARTMENT STORE

25th Anniversary

1948 marks the 25th Anniversary of Republic Rubber Division's 5-Point Sales Policy. This policy, by intent, provides service to industry through carefully chosen distributors rather than branches, because, Republic believes it's a more economical and efficient way of doing business.

The department store with thousands of items serves you for routine and also special purchases. Likewise, your distributor of industrial supplies may furnish you with your every day requirements as well as "special" purpose items. He offers you many choices, and *one* order for several items replaces several time-consuming calls. Delivery may also include many products, thus saving storekeepers' time and bookwork. Only one check covers an accumulation of orders for the month and one payment replaces many payments.

Call the Republic Rubber Distributor and see for yourself how these and other services save time and money for you.

MECHANICAL RUBBER GOODS BY

REPUBLIC RUBBER DIVISION

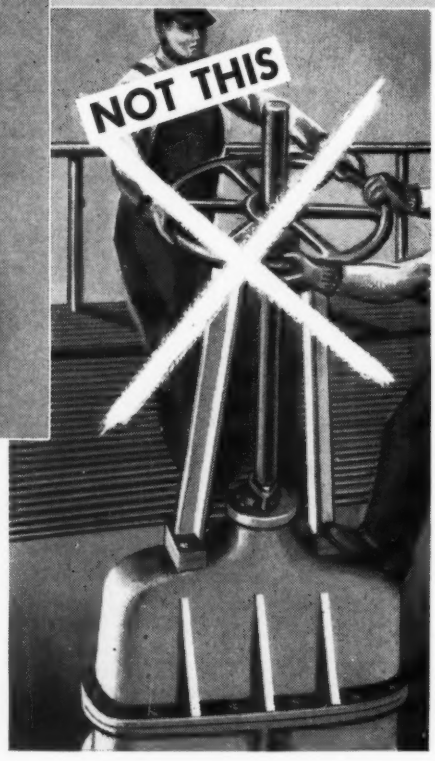
REPUBLIC RUBBER DIVISION
LEE RUBBER & TIRE CORPORATION . . . YOUNGSTOWN, OHIO
Lee DeLuxe Tires & Tubes, Conshohocken, Pa.

A well known process industry manufacturer:-

INCREASED PRODUCTION 57% THROUGH *Limitorque* VALVE CONTROLS

THIS IS AN ACTUAL CASE HISTORY INVOLVING 116 LIMITORQUES

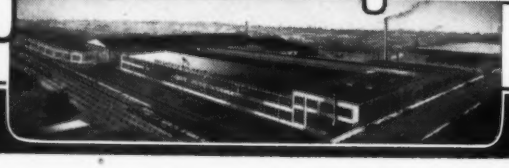
A prominent process industry manufacturer redesigned, several times, a special hand operated valve, endeavoring to secure positive shut-off—this in order to avoid contamination of the product manufactured, and also endeavor to increase the yield—but their efforts met with no success. Our engineers were called in, and LimiTorque Valve Control was applied and operated by a momentary contact Push-Button Station. The result was that yield immediately jumped from 72% of anticipated to 113%—or an increase of 57%— and all this was accomplished by the application of LimiTorque Controls. Further, labor costs of two men on a hand wheel operating valve, for twelve minutes at a time, was reduced to one-quarter of a second through push-button actuation on a LimiTorque Valve Control. It is also interesting that the "controlled positive positioning" (through the torque-seating mechanism of the LimiTorque) coupled with "position indicating lights" in the Push-Button Station, made this possible.



The "LimiTorque" (at left) is for valves working at low to medium temperatures, low to high pressures, and normal speed of operation.
This Unit is mounted on top of valve yoke . . . no extra gears, nuts or bearings required. Stem nut is inside and furnished with Unit. All clutches and connecting sleeves are eliminated.
LimiTorque is designed for plug, cock, gate and globe valves . . . Entire Unit can be lifted off valve yoke, by removing flange bolts, without disturbing wiring.
A special high starting torque motor, reduction gears, limit switches, all in one weatherproof assembly—and all electrical connections are made to one terminal board, easily accessible by removal of watertight cover. A handwheel is provided for manual operation and does not revolve during motor operation. During hand operation motor is mechanically disengaged. LimiTorque is always operative electrically. No danger to operator should he be turning handwheel when motor is started, since automatic clutch disengages handwheel instantly, without shock. Declutch lever changes from motor to hand operation. The LimiTorque "hammerblow" device allows motor to reach full speed before load is engaged. This imparts the "hammerblow" necessary to unseat sticking valve.
Torque seating switch insures tight valve closure without strain on valve parts. Protection from damage due to a foreign object obstructing closing is provided, because motor is shut off by thrust exerted on valve disc. Valve is protected during entire closing operation.

New 96 page catalog on LimiTorque Valve Controls will be sent upon request. When writing, please use your business letterhead.

Philadelphia Gear Works, INC.



ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
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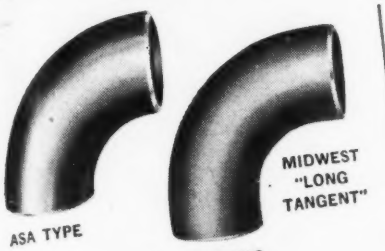
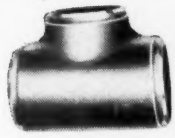
Industrial Gears and Speed Reducers
LimiTorque Valve Controls

IMPROVE PIPING DESIGN and REDUCE COSTS with . . . MIDWEST WELDING FITTINGS

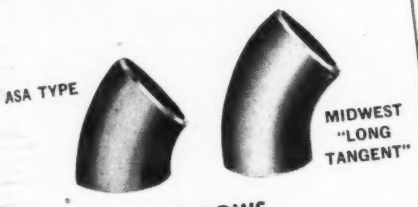


90° ELBOWS

REDUCING ELBOWS



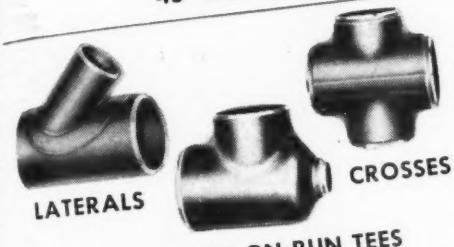
TEES



45° ELBOWS

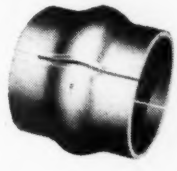
180° RETURNS

LAP-JOINT STUB ENDS

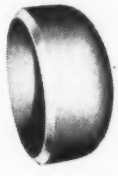


REDUCING-ON-RUN TEES

REDUCERS



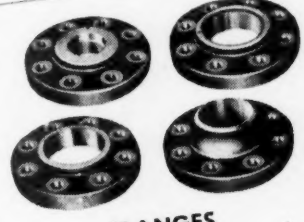
SLEEVES



CAPS

SADDLES

SHAPED NIPPLES



FLANGES

To simplify and improve piping design, Midwest originated and developed many of the fittings shown here. For example: the Midwest Reducing Elbow (available in sizes including 12") decreases turbulence and pressure drop when used instead of a standard elbow and a reducer; more than one third of the welding is also saved. Midwest Long Tangent Elbows save pipe and time in lining up. Midwest Saddles compensate for weakening of header body resulting from metal removed for nozzle opening. Midwest Welding Fittings stocks are carried in all principal cities . . . get in touch with your distributor.

MIDWEST PIPING AND SUPPLY COMPANY, Inc.

Main Offices: 1450 South Second Street, St. Louis (4), Mo.

Sales Offices: New York (7), 30 Church St.
Chicago (3), 79 West Monroe St. • Los Angeles (33), 520 Anderson St. • Houston (2), 229 Shell Bldg.
Tulsa (3), 533 Mayo Bldg. • South Boston (27), 426 First St. • Distributors in Principal Cities.

CENTRIFUGAL PUMPS FOR EVERY LIQUID

"What's OVERSIZE CONSTRUCTION got to do with lower pumping costs?"

"It cuts the BIG costs REPAIR-REPLACEMENT -and SHUTDOWN costs!"

"BUFFALO" 4-STAGE CLASS "RR" PUMP

A unit you can put on clear water service, high pressures, any temperature—without worrying about maintenance troubles. Handles up to 500 gpm, at power-saving efficiency.

PUMPS by "Buffalo"

For

- ★ WATER ANY TEMPERATURE
- ★ PAPER STOCKS (NON-CLOGGING)
- ★ GENERAL SERVICE
- ★ ACIDS
- ★ ALKALIS
- ★ SLURRY
- ★ CONDENSATE RETURN
- ★ SUMP CLEARANCE
- ★ FIRE SERVICE
- ★ SEWAGE
- ★ SELF-PRIMING SERVICE

SAVE ON *ALL* COUNTS —*with* "BUFFALO" PUMPS

The entire "Buffalo" line of pumps is built with two economies in mind: (1) maintenance savings and (2) power savings. Every part that COULD wear is EXTRA HEAVY—bearings, shafts, impellers. Stuffing boxes are extra deep. *No wonder so many "Buffalo" Pumps are "still going strong" after thirty or more years!* As for power savings, many are giving up to 75% efficiencies.

Write us about your pumping need. Let us show you how to save where saving counts!

BUFFALO PUMPS, INC.

488 BROADWAY BUFFALO, N. Y.

Canada Pumps Ltd., Kitchener, Ont.

RUGGED, PRECISION CONSTRUCTION—FOR LONG LIFE

next step is SANTOSITE

controls oxygen corrosion

To guard against corrosion and thus contribute to longer and more efficient service, new boiler installations should be protected from the start with Santosite (Monsanto Sodium Sulfite, Anhydrous, Technical).

When added to boiler feed water, Santosite removes all traces of residual oxygen—by combining with it to form sodium sulfate, which is water-soluble under boiler conditions.

Treatment with Santosite is simple. Merely maintain a residual of 30 parts to 1,000,000 parts of water—this also assures protection against the occasional appearance of oxygen caused by unexpected overloads, or leaks in condensers, pump packing glands and vacuum-return heating systems. No test for dissolved oxygen is required.

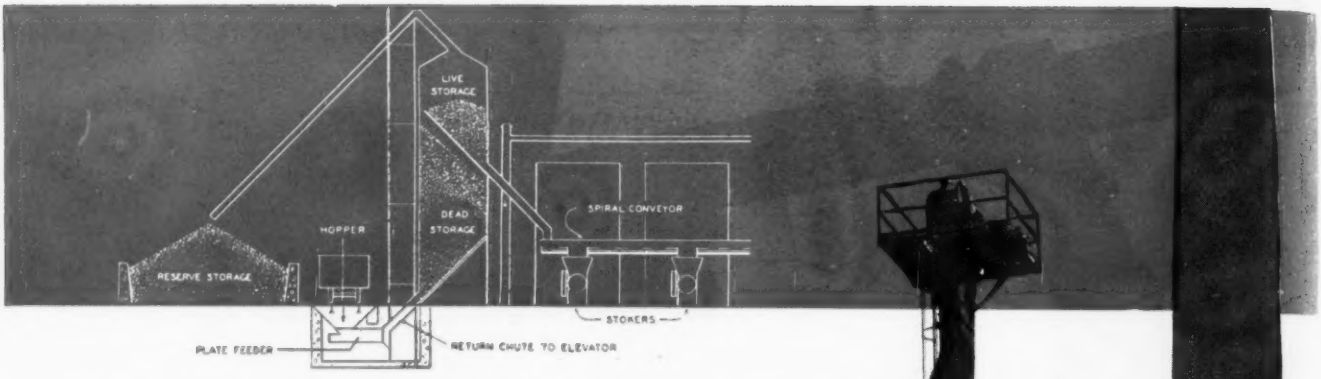
For complete application and technical data, send for a copy of Monsanto Technical Bulletin O-26, "Santosite for Removing Oxygen from Boiler Feed Water." Write to MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri, or ask for it on the coupon. *Santosite: Reg. U. S. Pat. Off.*

MONSANTO
CHEMICALS AND PLASTICS

MONSANTO CHEMICAL COMPANY PR-3
Organic Chemicals Division
1700 South Second Street, St. Louis 4, Missouri
Please send me a copy of the Technical Bulletin on Santosite.

Name_____ Title_____
Company_____
Address_____
City_____ State_____

SERVING INDUSTRY . . . WHICH SERVES MANKIND



ENCLOSED STORAGE WITH SPIRAL FEED

Here's another typical Jeffrey installation with the advantages of handling large capacities in minimum space. For this and other coal and ash handling economies our Power Plant equipment Catalog No. 778 will come in handy. Send for your copy TODAY.

A Jeffrey spiral Conveyor delivers directly to stokers from the silo chute (see drawing above). Alternate methods utilize apron feeders, electric vibrating feeders, belt conveyors, skip hoists or weigh larries.

THE JEFFREY MANUFACTURING COMPANY

ESTABLISHED 1877

932-99 North Fourth St., Columbus 16, Ohio

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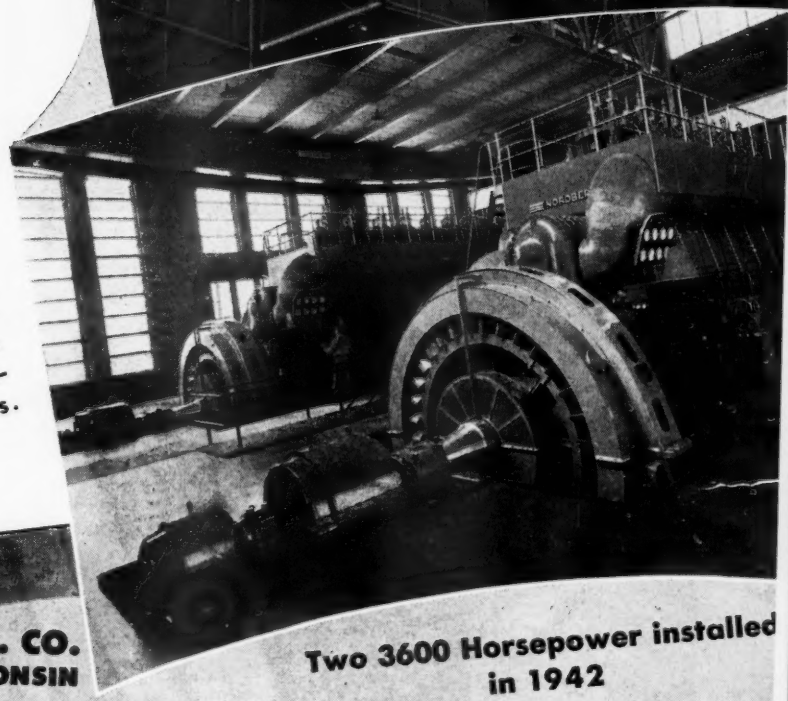
Complete Line of Material Handling, Processing and Mining Equipment

More Generating Capacity . . .

another NORDBERG DIESEL

7100 Horsepower installed in 1947

• When additional generating capacity was required for the Marshalltown, Iowa plant of the Iowa Electric Light and Power Company, a survey showed that the most economical solution was the installation of another Diesel unit. With the addition of the ten cylinder 29" x 40" engine shown above, the Marshalltown plant has a total of 14,300 horsepower in Nordberg Diesels and is one of the largest Diesel powered central stations in the country. Here is another instance where a Diesel plant operating in parallel with steam plants for peaking service on a large central station system shows exceptional overall operating economies.



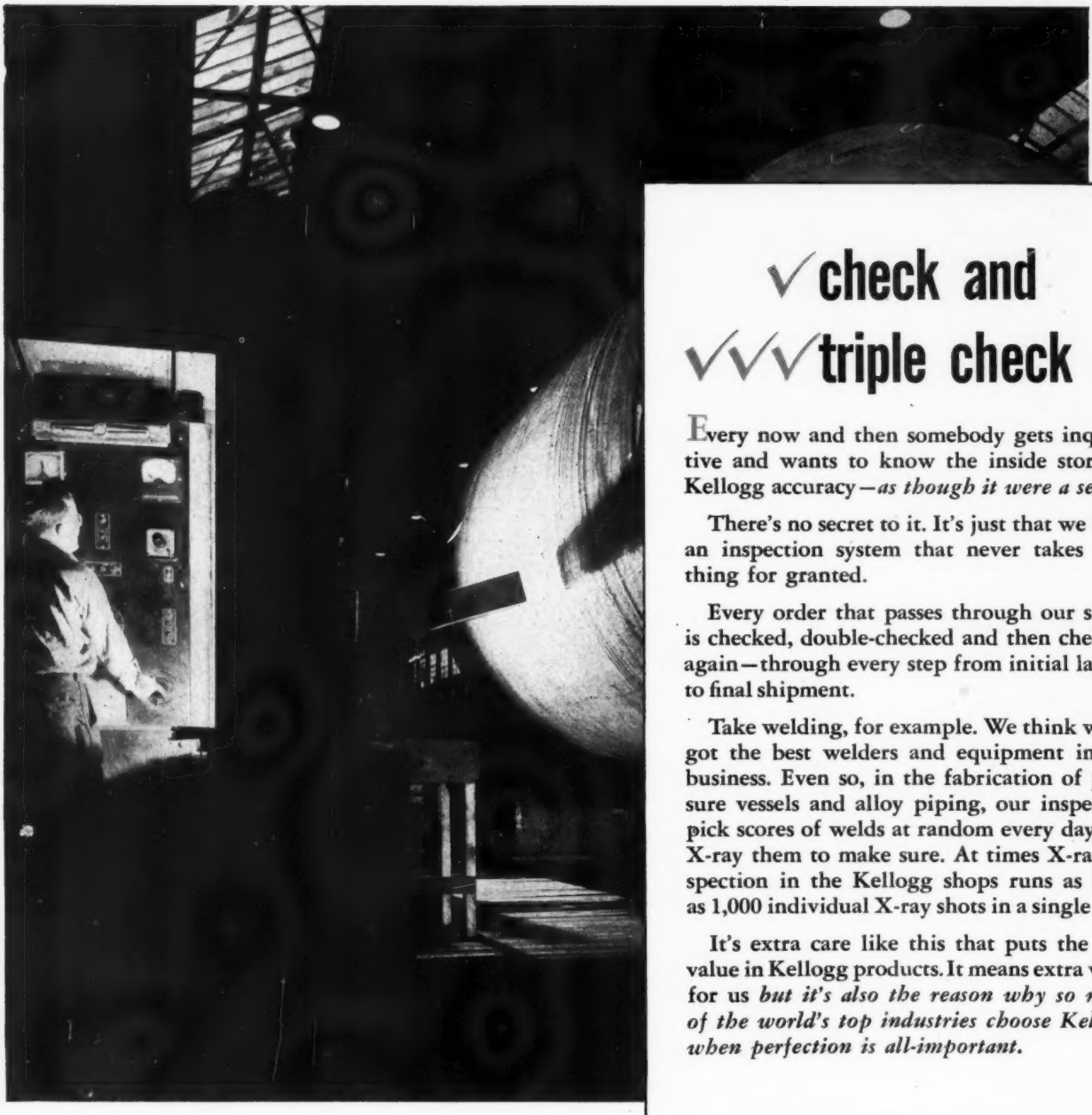
Two 3600 Horsepower installed in 1942

NORDBERG MFG. CO.
MILWAUKEE 7, WISCONSIN

BUSCH-SULZER
A DIVISION OF NORDBERG

NORDBERG
DIESEL ENGINES

NORDBERG MACHINERY



✓check and ✓✓✓triple check

Every now and then somebody gets inquisitive and wants to know the inside story of Kellogg accuracy—*as though it were a secret.*

There's no secret to it. It's just that we have an inspection system that never takes anything for granted.

Every order that passes through our shops is checked, double-checked and then checked again—through every step from initial layout to final shipment.

Take welding, for example. We think we've got the best welders and equipment in the business. Even so, in the fabrication of pressure vessels and alloy piping, our inspectors pick scores of welds at random every day and X-ray them to make sure. At times X-ray inspection in the Kellogg shops runs as high as 1,000 individual X-ray shots in a single day!

It's extra care like this that puts the plus value in Kellogg products. It means extra work for us *but it's also the reason why so many of the world's top industries choose Kellogg when perfection is all-important.*

FABRICATED PRODUCTS DIVISION

THE M. W. KELLOGG COMPANY

A SUBSIDIARY OF PULLMAN INC.

NEW YORK • JERSEY CITY • BUFFALO • LOS ANGELES
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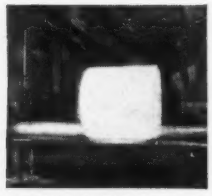
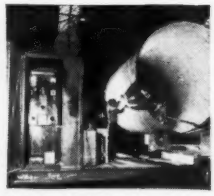
VESSELS • EXCHANGERS • CONDENSERS • HIGH PRESSURE AND HIGH TEMPERATURE POWER PIPING
PROCESS PIPING • FORGED AND WELDED FITTINGS . . . IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS

Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.

Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.



Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.

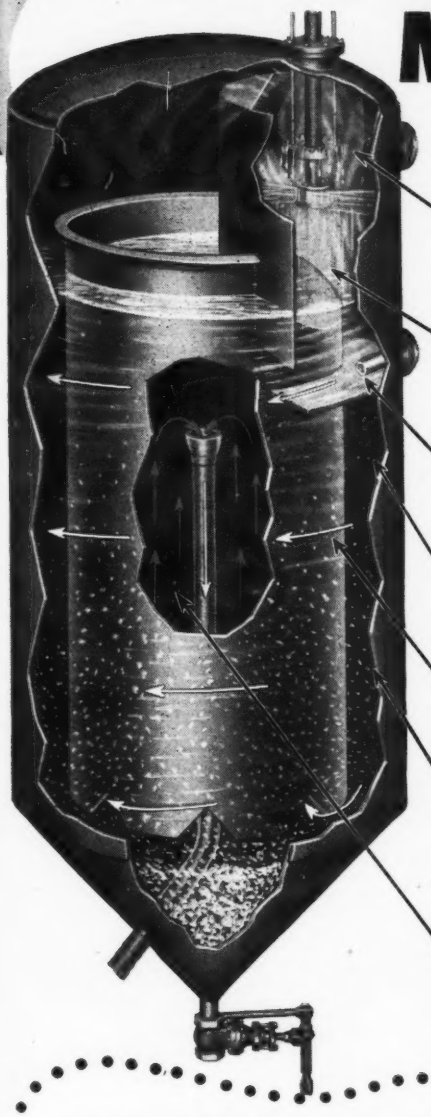


Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.

Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.

MAXIMUM Water Treatment MINIMUM Chemical Cost



Here's How Hot-Flow* Softener Converts Water, Steam, Chemicals into Safe Boiler Feed Water

1. The Hot-Flow tank serves the dual purpose of providing a housing for the feedwater treating equipment and the necessary reaction and sedimentation facilities.
2. A mixing compartment immediately below the raw water heater, between the central uptake and the outer tank in which water and chemicals (and returned sludge, when sludge recirculation is employed) are thoroughly mixed.
3. A deflector plate, forming the bottom of the mixing compartment, discharges the mixture tangentially into the outer annular compartment, and prevents turbulence of entering water from being transmitted to the reaction and settling space below.
4. Slow, spiral, downward travel for completion of reactions and precipitate formation and agglomeration.
5. A central uptake compartment, having a cross sectional area equal to the annular outer ring, in which the treated water rises *without increase in velocity* to the point of take-off.
6. A "blanketing" effect of the annular compartment surrounding the central take-off compartment eliminates short circuiting from inlet to outlet resulting from convection currents caused by temperature changes and radiation.
7. Adequate facilities for providing hot treated water for filter washing (from the central uptake); and for the return of the dirty wash water to the outer annular compartment for recovery and re-use. No other hot process equipment has *this* exclusive advantage.

As a result of these unique design features, you can be sure the Hot-Flow Softener will provide you with the maximum of treatment benefits and chemical economy.

* Trade-mark Reg. U. S. Pat. Off.

EXCLUSIVE DESIGN

The Hot-Flow Softener tank is divided into two compartments of equal volume. Chemicals and heated raw water are mixed in the upper annular section above a stilling plate. Chemical reaction is completed as the mixed chemicals and water flow slowly around and downward in the annular section. At the bottom, treated water separates from the precipitate and rises in the central cylindrical uptake to the takeoff, while the sludge settles to the bottom of the tank.

INFILCO

WATER CONDITIONING and Waste Treatment Equipment

RESEARCH FIRST for Over FIFTY YEARS ENGINEERING

Write or Call Nearest Field Engineer or Chicago Headquarters

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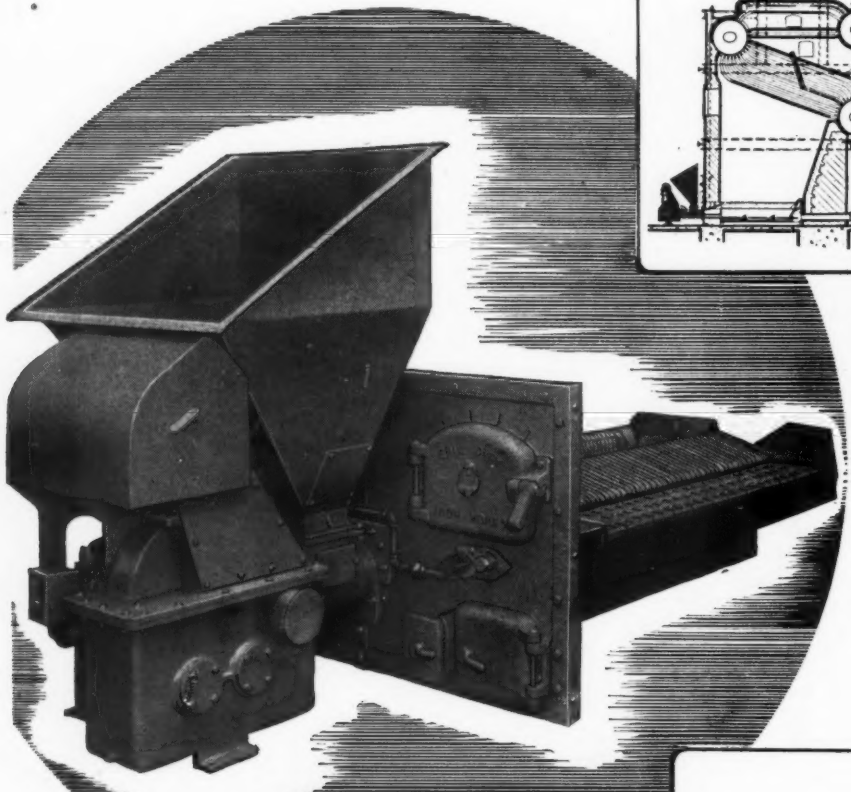
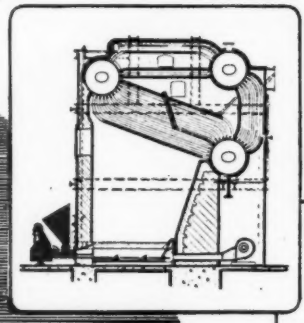
INFILCO INC. • 325 WEST 25TH PLACE • CHICAGO 16, ILLINOIS

ERIE CITY'S NEW STOKER

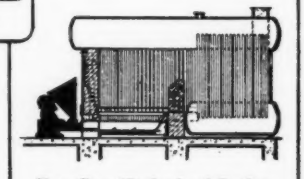
Combines with 5 Erie City Boiler-Furnace Units

The new Erie City Underfeed Stoker, completely built in our foundry and shops, backed by over 100 years of "know how" in boiler firing, was primarily developed to team up with Erie City Boiler-Furnace units. Erie City's new stoker embodies the best features of modern stoker design. A special heat resisting alloy iron was developed in our foundry for all castings exposed to the fire. All parts are of extra heavy design to assure long life and low maintenance. Erie City Stokers are available in two types to meet any single retort Underfeed Stoker firing need, each in a wide range of sizes. Write for catalog.

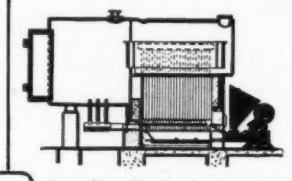




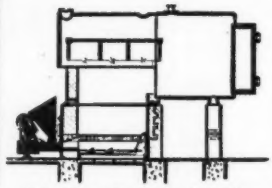
Erie City Underfeed Stoker firing Erie City Type C 3-Drum Boiler



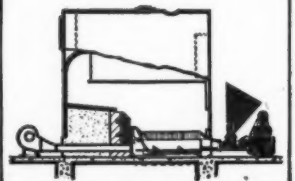
Erie City Underfeed Stoker firing Erie City Type VL Boiler



Erie City Underfeed Stoker firing Erie City Water Wall Economic



Erie City Underfeed Stoker firing Erie City Standard Economic



Erie City Underfeed Stoker firing Erie City Heating Boiler

● COMPLETE STEAM POWER PLANT EQUIPMENT

ERIE CITY

Complete Steam Generators ● Type C 3-Drum Boilers ● Type VL 2-Drum Boilers ● The "Economic" Boiler with or without Water Walls ● Welded H. R. T. Boilers ● Welded Steel Heating Boilers ● Coal Pulverizers ● Underfeed Stokers ● Welded Pressure Vessels for the Process Industries.

ERIE CITY IRON WORKS • ERIE, PA. • *Since 1840*

Bull Dog Fractional Horsepower (FHP) V-Belts available in three standard sections, full range of lengths.

Bull Dog Industrial V-Belts available in A, B, C, D and E Sections in a full range of lengths.

YOU SHOULD INVESTIGATE THE SENSATIONAL

New Bull Dog V-Belts!

"THEY'RE TERRIFIC"...

That's the comment we've heard on all sides, since these rugged new Bull Dog V-Belts were put on the market last month. And in big industry, where they had been previewed and tested in grueling workouts, "Bull Dogs" more than lived up to their name. Day after day, under strenuous working conditions, they demonstrated exceptional tenacity and stamina.

What accounts for this greater efficiency in Bull Dog V-Belts? BWH experience, for one thing. For more than 70 years we've been famous for industrial rubber products that give you EXTRA service. And our technologists have built exceptional capacity for long, trouble-free performance into every inch of these new V-Belts.

The new BWH Bull Dog V-Belts are designed with these outstanding advantages:

1. ***Exclusive Bull Dog Cord Section with Higher Tensile Strength*** — able to carry the load, absorb shock.
2. ***Low Stretch*** — because Bull Dog Cords are processed in a new way. This means less slippage, fewer adjustments, longer belt life.
3. ***Cool Running*** — quality-controlled compounds developed in BWH laboratories don't crack or deteriorate under severe flexing.
4. ***Wear-Resistant Covers*** — made of bias-cut heavy fabric to protect the heart of the belt from dirt, grease, and moisture.

SPECIFY BULL DOG V-BELTS FOR

"MORE POWER TO YOU"

Bring us your toughest problems . . . we're specialists in solving them. Where stamina counts, turn to BWH for rubber products of dependable ruggedness—BWH distributors for dependable service.

Another Quality Product of

BOSTON WOVEN HOSE & RUBBER COMPANY

Distributors in all principal cities

PLANT: CAMBRIDGE, MASS., U. S. A. • P. O. BOX 1071, BOSTON 3, MASS.

. . . You get everything . . .

your piping job needs

in the TAYLOR FORGE *line*

Widest range of types . . . sizes . . . weights . . . materials

To Taylor Forge "full line" means just what it says. The broad Taylor Forge line—more complete than that of any other manufacturer—includes practically every type of fitting, every weight, every size, and every material ever needed in pipe welding.

Yes, Weldells have everything

TAYLOR FORGE & PIPE WORKS

General Offices & Works: Chicago 90, Ill. (P. O. Box 485)

EASTERN PLANT: CARNEGIE, PA.

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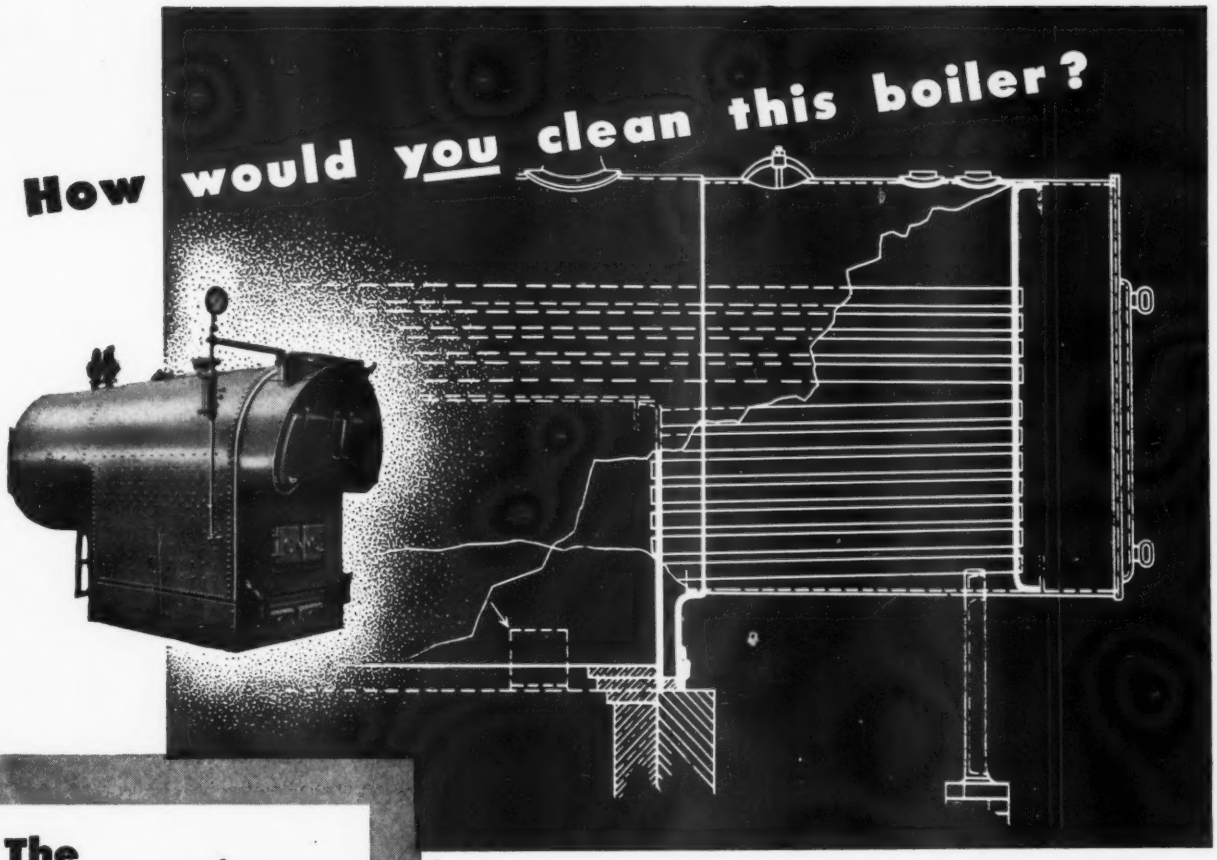
New York: 50 Church Street Philadelphia: Broad Street Station Bldg.
Chicago District Sales: 208 S. LaSalle Street
Houston: City National Bank Bldg. Los Angeles: Subway Terminal Bldg.

How would you clean this boiler?



The Pennsalt way . . . 6 hours

Here's how Pittsburgh Tube Company cut boiler-cleaning time in half . . .

This is a 1500 gallon boiler with 100-odd 3″ fire tubes arranged in a staggered bundle. The first time Pittsburgh Tube Company cleaned it to remove hard water scale, they used hammer and chisel. This took about 16 hours . . . and was unsatisfactory because of the inaccessibility of the center tubes.

So, next time they called in boiler-cleaning specialists* who used Pennsalt PM-90 descaling compound to get *better* cleaning *in only 6 hours*. Here's how:

Water, at operating level, was heated to 150°F. Then PM-90 was added until acid-water ratio was 1:5. Solution was agitated with an open steam line for about 1½ hours . . . at which time acidity became constant. Boiler was then drained, rinsed, neutralized with 100# Pennsalt alkaline cleaner, rinsed again, and inspected.

Results were highly satisfactory . . . just as they have been for many other Pennsalt PM-90 users. PM-90 is a *specialty* acid-type cleaner . . . stable, thorough, safe to base metals. For better, more economical boiler descaling, use Pennsalt PM-90. Yes, we'll gladly give engineering help. Special Chemicals Division, Pennsylvania Salt Manufacturing Company, Philadelphia 7, Pa.

*MORRISON AND WALTON, LINESVILLE, PA., DESCALING ENGINEERS.

PENN SALT

chemical cleaning compounds

HOPPES
FEEDWATER HEATERS

Deaerating and Non-Deaerating

Write for Bulletin

The Hoppes Mfg. Co., Inc.

Established 1881

SPRINGFIELD OHIO

DUDGEON

HIGH EFFICIENCY

TUBE EXPANDERS

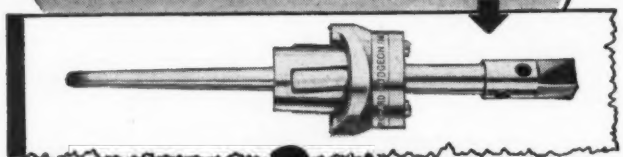
Quality-built to lower your costs!

It means a lot to the user to know that each DUDGEON expander can be unqualifiedly depended upon to give consistently good results . . . quickly, with less effort. It means a lot to the buyer, too, toward lower unit costs and better workmanship. This confidence—implicit in DUDGEON products for almost a century—results from the same modern manufacturing techniques and rigid quality control that have consistently raised the quality and lowered the costs of these fine tools.

Complete literature on Dudgeon products — expanders, hydraulic pumps and jacks — available. Write today to Department

DUDGEON TYPE 22

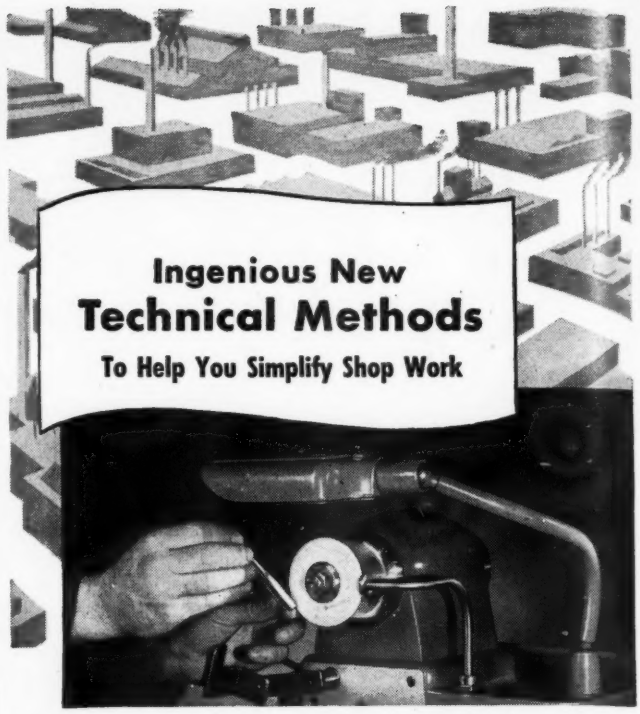
Highest quality tool obtainable for all tube rolling in railroad and boiler repair work. Simplified design provides unusual economy. Hardened guide ring bears against hardened one piece frame for maximum resistance against grit and scale. Rollers are reversible.



RICHARD Dudgeon INC.

MFRS. OF TUBE EXPANDERS SINCE 1853

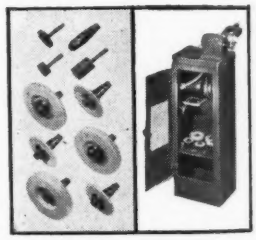
24 COLUMBIA STREET, NEW YORK 2, N. Y.



Versatile New Grinder Saves Time —Improves Grinding Efficiency

A new grinder, the Corlett-Turner G-3, permits changing of grinding wheels in a matter of seconds and assures a true running wheel at all times. Each wheel is individually mounted on a ground, tapered arbor.

Easy wheel changing is accomplished by a slight wrist motion on the end bells of the grinder head. A twist to the left releases the wheel arbor; the reverse action instantly secures it in place. It's all done in a matter of seconds. No costly time is lost in repeated wheel dressing.



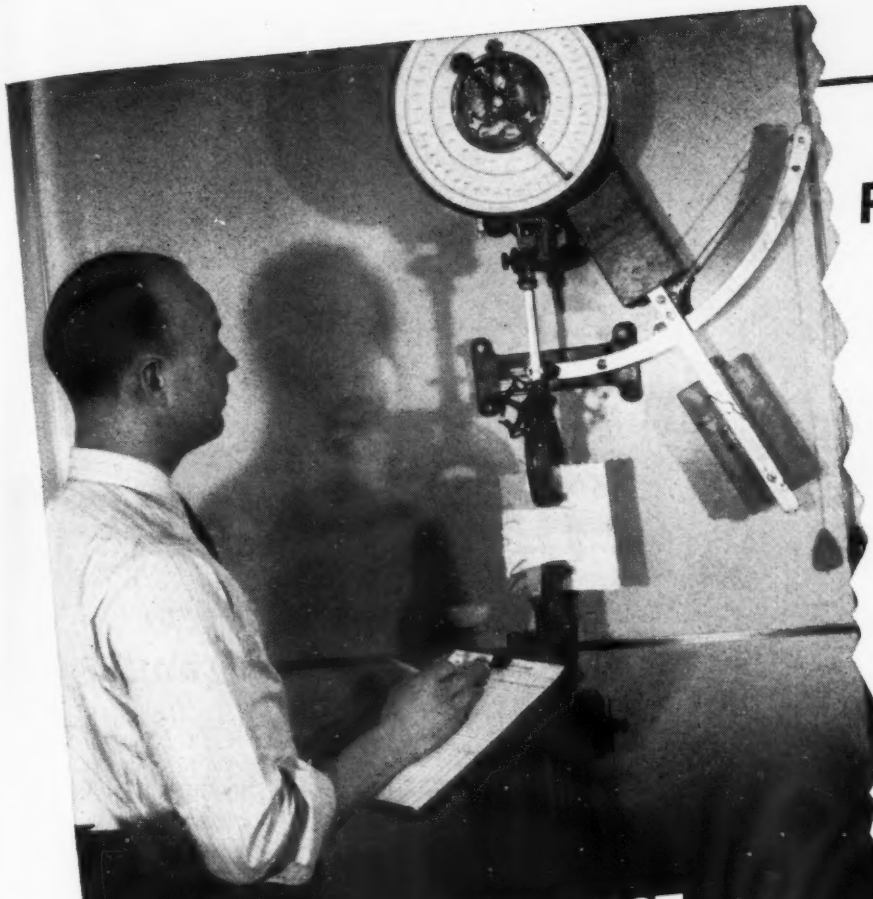
Grinding Wheels — Corlett-Turner Grinder

In addition to its primary function, the G-3 grinder has innumerable uses for burring, buffing, polishing, and production applications requiring a high speed spindle. Powered by a 1/3 horsepower motor, a three-step pulley arrangement provides speeds of 5600, 8000, and 12,000 r.p.m.

Efficiency in precision work is also increased when tension is relieved by the act of chewing. And chewing Wrigley's Spearmint is a pleasant, easy way to help relieve workers' nervous tension. For these reasons Wrigley's Spearmint Chewing Gum is being made available more and more by plant owners everywhere.

Complete details may be obtained from Corlett-Turner Co., 1001 S. Kostner Ave. Chicago 24, Illinois

AC-67



STRETCH TEST STRENGTHENS SERVICE LIFE

Quaker Pre-Tested Products Assure Positive Performance

Pulling . . . stretching . . . breaking the fabric that goes into Quaker products is just one of the more than eighteen tests to produce top quality in every one of the 9001 carrying the Quaker trade-mark.

The tensile test shown above is to assure fabric for belts that will meet and beat the recommended horsepower transmission . . . hose that will withstand all pressures encountered under working conditions.

When you specify Quaker products, you are sure of peak performance—pre-tested in the laboratory and performance proved throughout industry. For higher plant efficiency and lower operating costs, call your nearest Quaker distributor. He and the Quaker sales engineer are teamed to provide accurate recommendations on belting, hose and packings.

QUAKER RUBBER CORPORATION

PHILADELPHIA 24, PA. • New York 7 • Cleveland 15 • Chicago 16 • Houston 1

Western Territory

QUAKER PACIFIC RUBBER CO. • San Francisco 5 • Los Angeles 21 • Seattle 4

Quaker Pre-Testing OFFERS THE POWER INDUSTRY

BELTING FOR MAXIMUM HORSEPOWER TRANSMISSION

Huge flat belts driving large flywheels or small fractional horsepower drives on small motors . . . Quaker pre-testing develops belts for every need of the Power industry . . . belts to assure peak efficiency under all operating conditions.

HOSE THAT STANDS WEAR AND ABRASION

Hose for air, steam, water, oil, gas, chemical, fire, or paint, Quaker makes it and makes it to fit the needs of the Power industry . . . each length of Quaker hose is made right . . . pre-testing assures peak-performance.

PACKINGS FOR TIGHTER SEALS . . . LONGER WEAR

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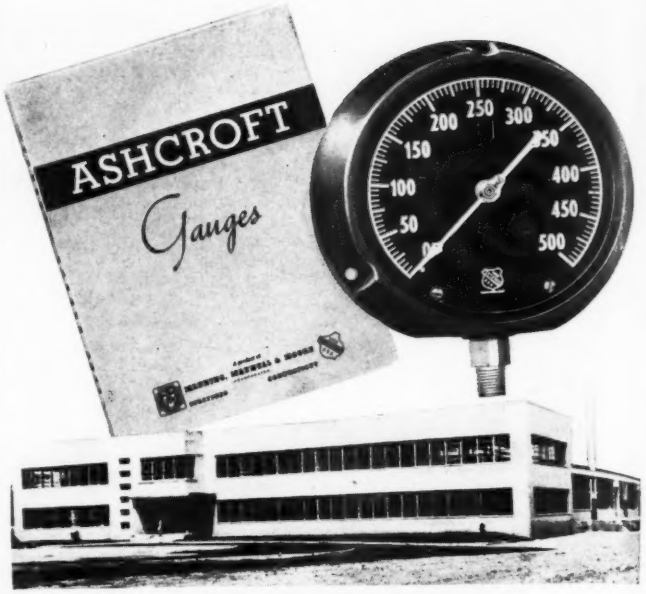

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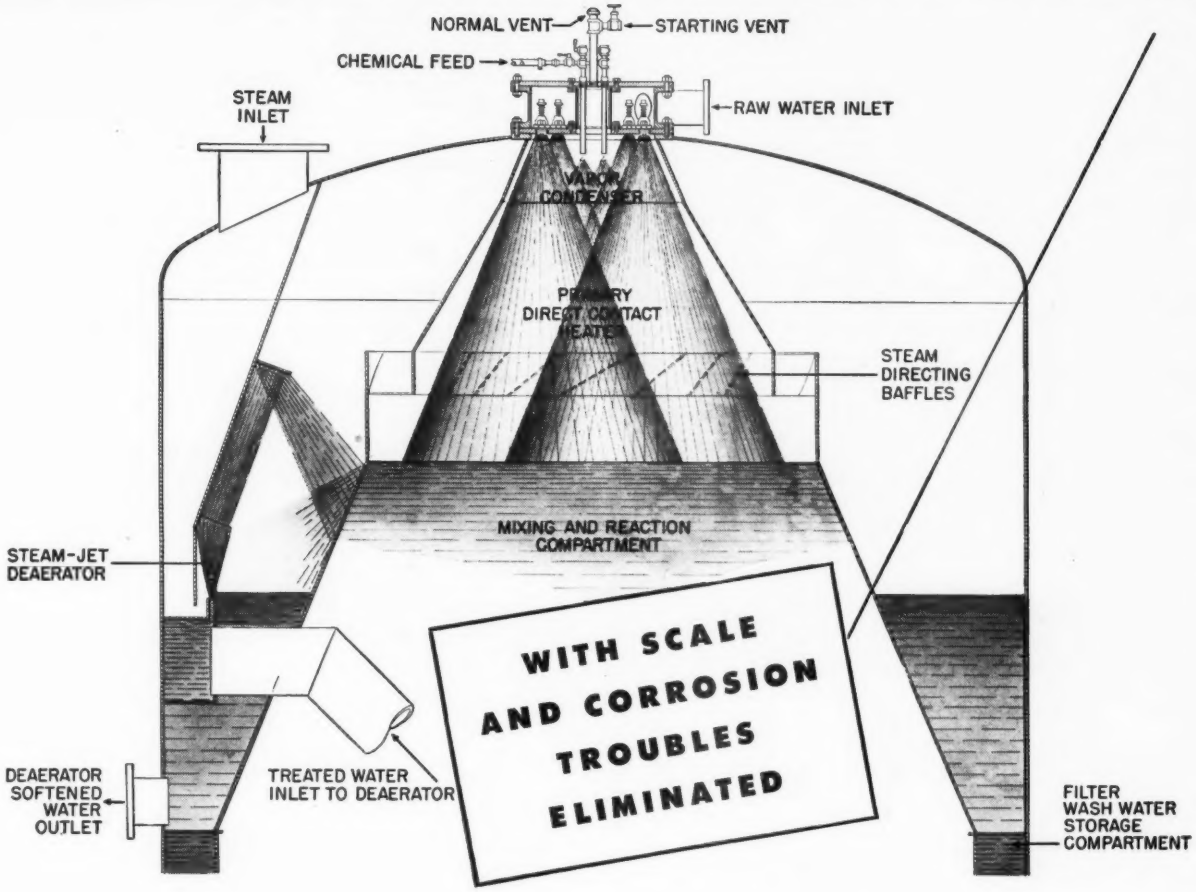

The tubular vent condenser which Worthington Research and Engineering previously eliminated on deaerators is now no longer a necessary part of the water softener!

Worthington research has developed a hot process deaerating softener in which the displacement flow path for steam is so designed that non-condensibles are separated from the water and concentrated for removal with negligible thermal loss—*without the need of tubular vent condenser.*

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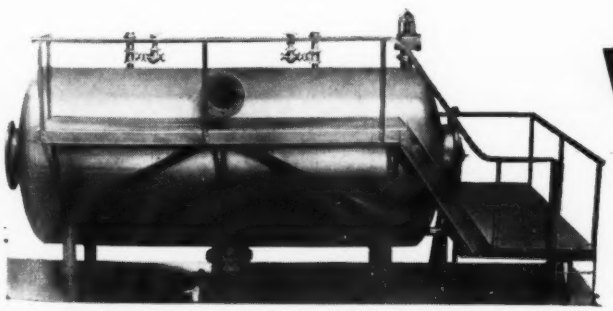

A Worthington deaerator *without vent condenser*

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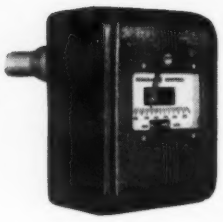

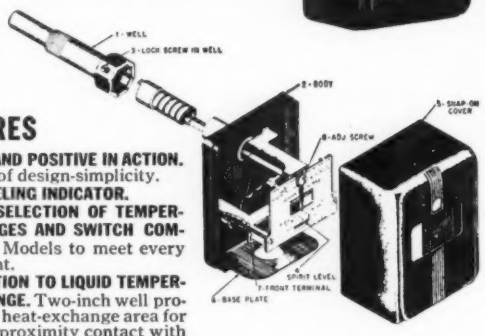

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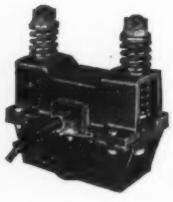

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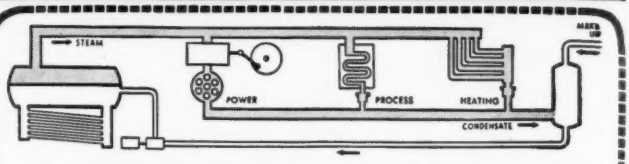

The CORAVOL-ZONE—indicated by the shaded area in the diagram—includes every part of a steam system not accessible to boiler feed water treatment. It includes the boiler above the water line, steam lines, condensate return lines, radiators, valves, traps and equipment. This zone can now be reached and protected against rust and corrosive action—by CORAVOL.

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The use of CORAVOL *in steam systems is covered by U. S. patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile amines purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.*

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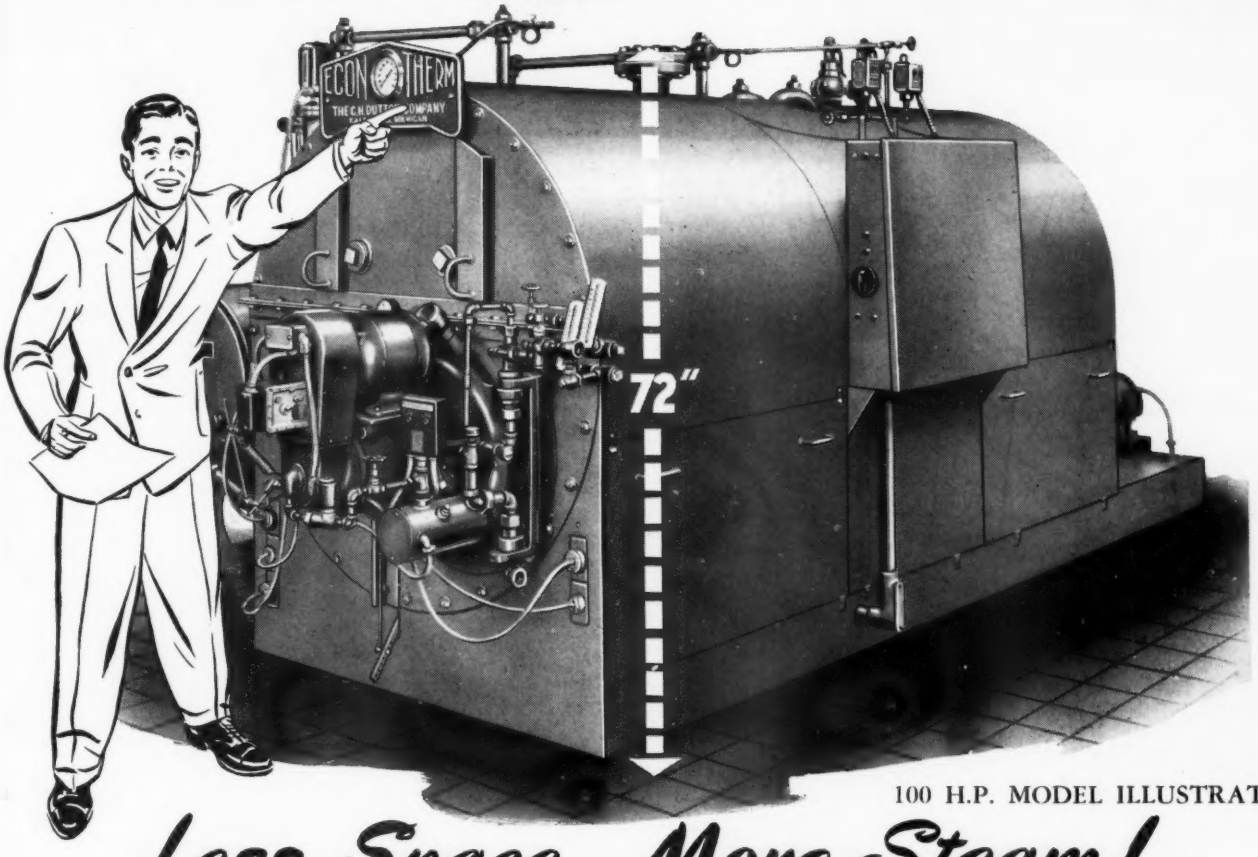

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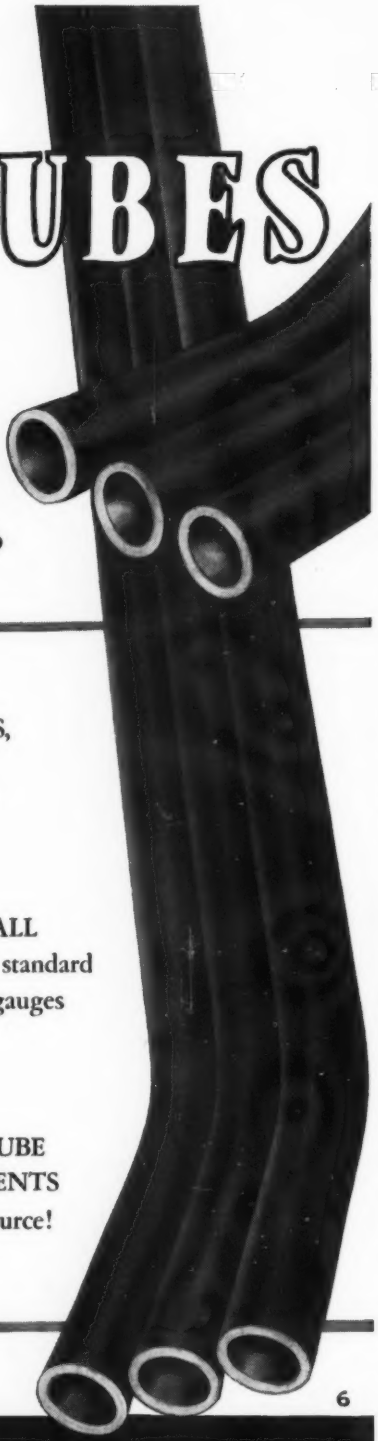

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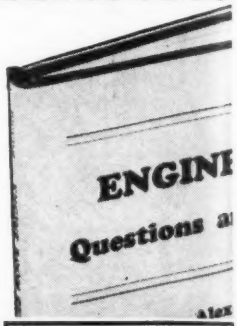

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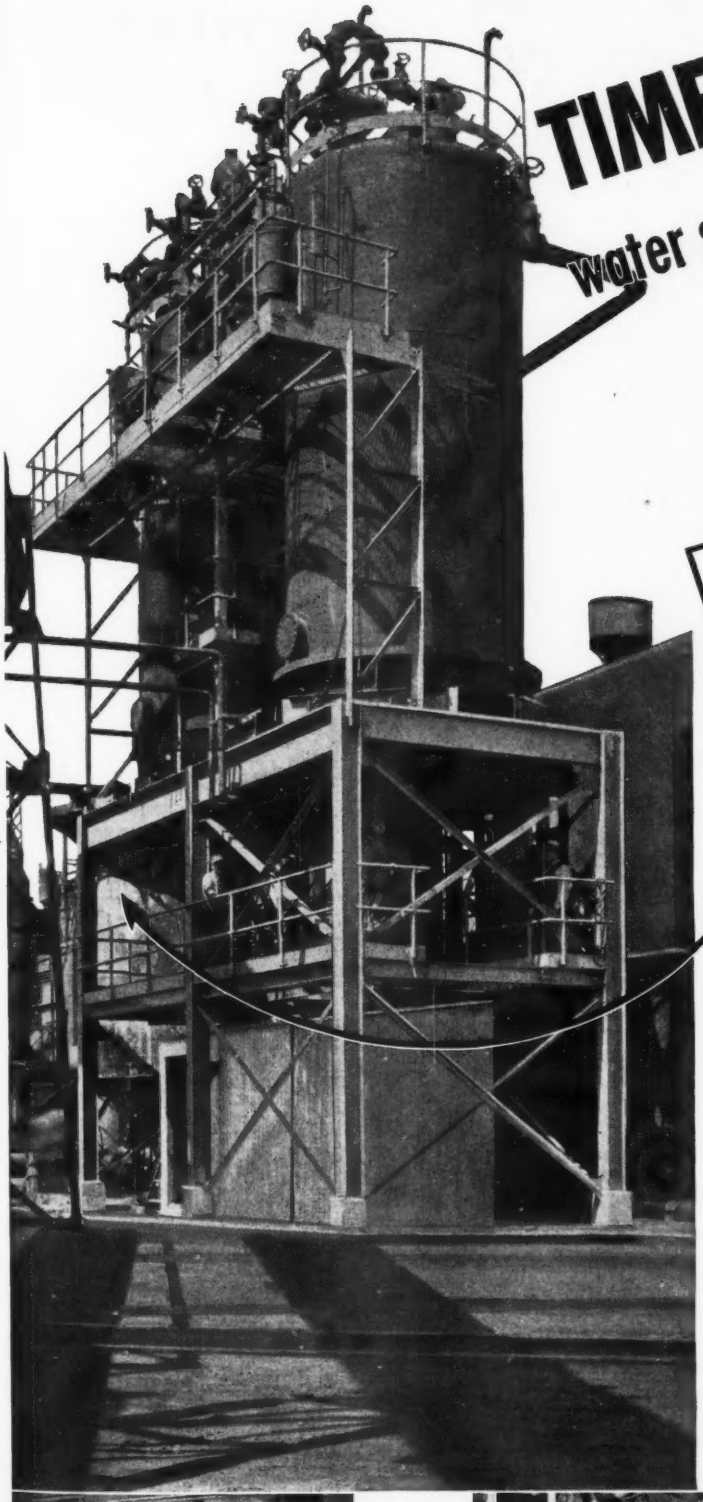

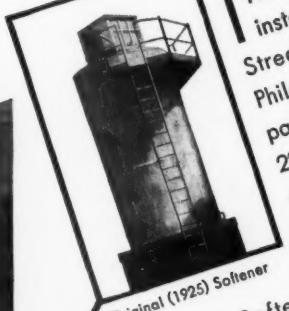

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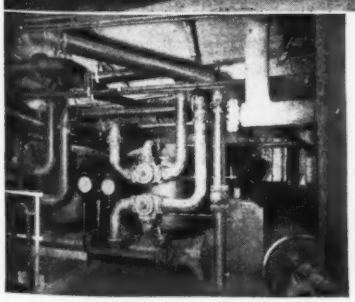
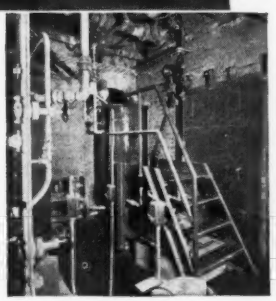
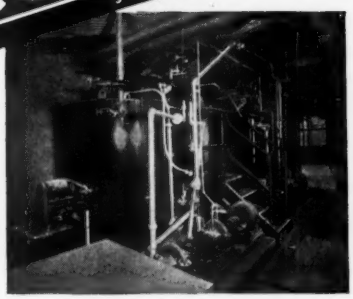


(Left) Two vertical pressure filters replacing existing conical filters shown in background



(Left) phosphate tank with motor driven agitator for mixing supplemental phosphate feed



(Left) Lime soda proportioners and mixing tanks

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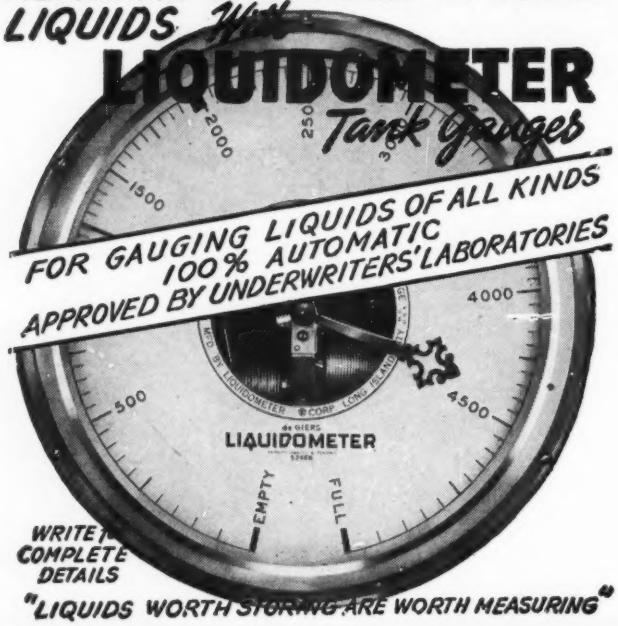

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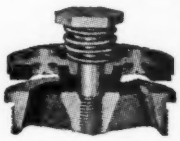

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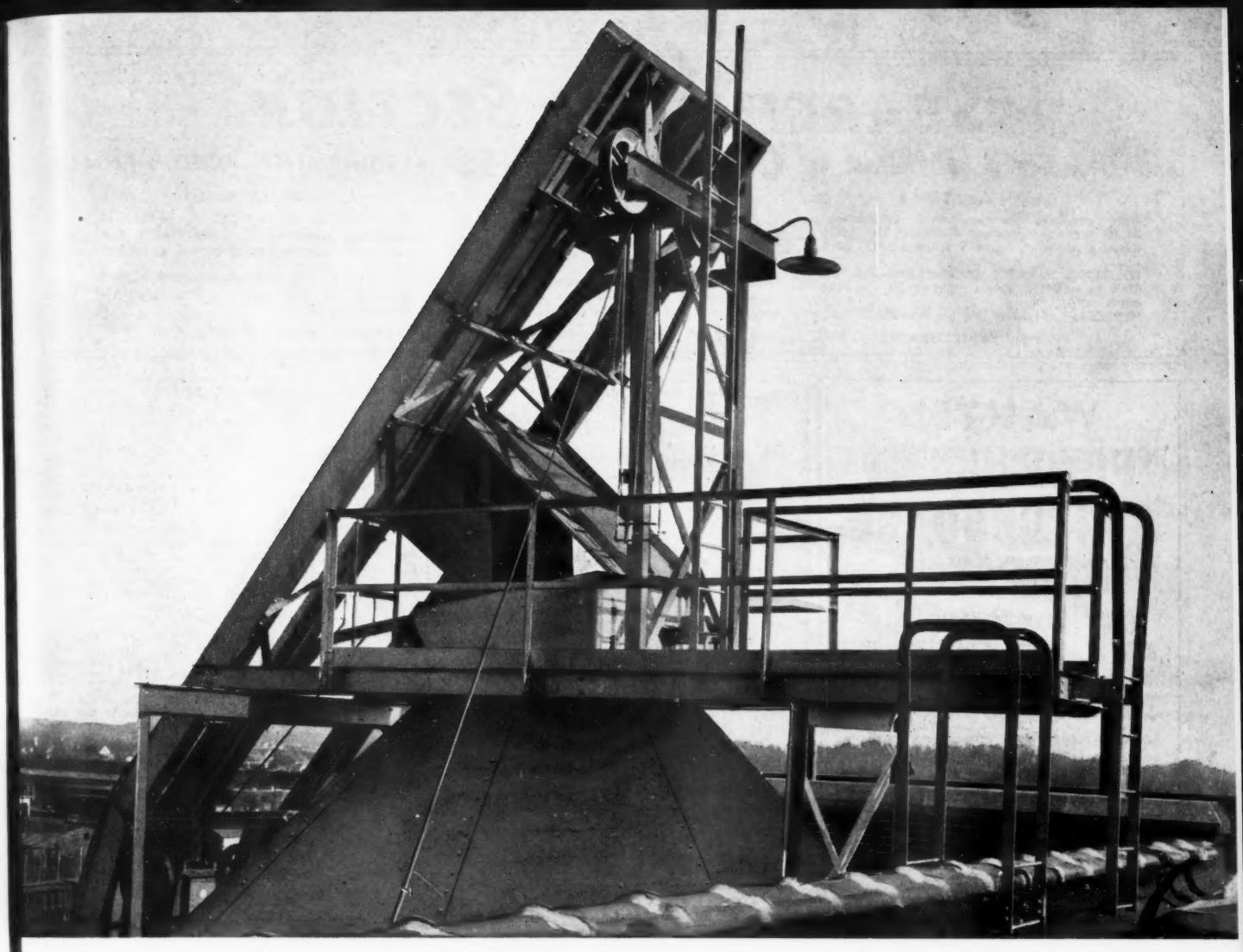
80 Broad Street, New York 4

THE REAL VALUE

of placing your unusual problem in the hands of a competent consultant is that it eliminates the elements of chance and uncertainty from the problem and provides real facts upon which to base decisions.



Broadening the Horizon
with their efficiency and economy

BARTLETT-SNOW SKIP HOISTS tick away the years to the rhythmic travel of their buckets. They have demonstrated their outstanding efficiency and dependability for handling limestone, sand, ashes, ores, sinter, and many other services when the lift is high and the material heavy or abrasive.

Skip Hoists have been widely used in handling coal in industrial boiler plants (see view of industrial head frame above) and because of the inherent advantages of their design have proven extremely well adapted for use in large central stations.

Skip Hoists have very few moving parts. Consequently they incur little wear and require little maintenance and repair. They are readily adaptable to receiving coal by rail, truck or waterway, and to coal storage and reclaiming systems using either a drag line or bulldozer.

Skip Hoists can be mounted inside ornamental type buildings. Because they are relatively unaffected by summer sun, or winter's ice and snow, they can also be mounted entirely outside the building. In either case they require a minimum of cubic space and little ground area. Furnished in a wide range of sizes;—semi-automatic or fully-automatic, counter-weighted or counter-balanced types to meet any capacity and operating requirement.

Send for a copy of our Bulletin No. 89. It describes Bartlett-Snow Skip Hoists in much detail,—and let Bartlett-Snow engineers, who perfected and installed the first commercially successful fully automatic skip hoist (still in use today), work with you on your next bulk handling problem. The C. O. Bartlett & Snow Company, Cleveland 5, Ohio. Engineering representatives in New York, Baltimore, Detroit and Chicago.

BARTLETT-SNOW
CLEVELAND 5, OHIO

COAL HANDLING SYSTEMS
for
CENTRAL STATIONS AND INDUSTRIAL BOILER PLANTS

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE:

(Not available for equipment advertising) $1.20 a line, minimum 4 lines. To figure advance payment, count 5 average words as a line.
POSITIONS WANTED (full or part-time individual salaried employment only), ½ the above rates.
PROPOSALS, $1.20 a line an insertion.

INFORMATION

BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 1 line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:

The advertising rate is $10.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅛ inch vertically on one column, 3 columns—30 inches—to a page.

P.

NEW ADVERTISEMENTS received by June 21st will appear in the Mid-July issue, subject to limitation of space available

WANTED
POWERHOUSE SWITCHBOARD OPERATOR

LARGE MANUFACTURING PLANT WITH 20,000 KW OUTPUT PER HOUR ROTATING SHIFT—40 HOURS WEEKLY

LOCATION: CONNECTICUT

In reply state age, education and experience—listing former employers, dates of employment and reasons for leaving.

P-5057, Power
330 West 42nd Street, New York 18, N. Y.

WANTED
Power Plant
Superintendent
Public Utility

needs experienced man at once to take complete charge of new power plant of 40,000 KW capacity at 850 p.s.i. Location Eastern New York. Send full details of experience.

P-5206, Power
330 West 42nd Street, New York 18, N. Y.

WANTED
CHIEF ENGINEER—POWER PLANT

Large Northern New England Utility has immediate opening for Chief Operating Engineer for 40,000 K.W. Generating Station now under construction. Technical graduate or equivalent with experience in operation at pressures in 600-800 range, age 35-40, preferred.

Early interview arranged for qualified applicant.

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
Masonic Building Dover, New Hampshire

MECHANICAL ENGINEERS
WITH 5 TO 15 YEARS EXPERIENCE
In Steam or Gas Plant Design
Write To
MECHANICAL ENGINEER
Pennsylvania Power & Light Company
Allentown, Pa.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

WANTED — ENGINEERS — Excellent opportunity for mechanical engineers and engineering draftsmen with large, expanding southern industry, for plant layout, machine design and mechanical and process development work. Experience in pulp, paper or allied industry desirable but not essential. State education, experience, age, salary, and availability. All details confidential. P-4395, Power.

WANTED—LARGE Industry with expansion program has opening for a steam and electrical engineer, capable of design and installation of steam plant and electrical equipment with opportunity as plant engineer after construction period. Give age, education and experience in first letter with salary desired. P-4571, Power.

WANTED: MAN capable of assisting in power plant supervision in large woodworking plant near Chicago. Requires good working knowledge of steam and electric generation, power plant maintenance and experience in power plant supervision. Give all pertinent information in first letter. All inquiries will be held confidential. The Singer Manufacturing Company, 2115 W. Western Avenue, South Bend, Indiana.

TEST ENGINEERS: With degree in Mechanical Engineering or Physics and three to five years experience in research or development work. For applied research on the flow of water, steam and air; metals under simulated service conditions; heat transfers; experimental stress analysis; all as applied to steam boilers and related equipment. Unusual opportunity for men in new research and development laboratory. The Babcock & Wilcox Co., Research & Development Department, Alliance, Ohio.

OLD ESTABLISHED valve manufacturer has openings for two experienced engineers. One is required with design experience and one with experience in modern quantity production and routing. Both an engineering education and experience are essential for these positions as only top-flight talent is desired. A complete statement of qualifications should be forwarded with first communication which will be held in strictest confidence. P-5005, Power.

DRAFTSMAN, DESIGNING. Experienced on structural steel and reinforced concrete. College graduate well qualified in design theory with some constructional experience, would have excellent possibilities for future advancement either in design or constructional engineering. Location, Central Michigan. State complete qualifications in application. P-5052, Power.

Mechanical Design Engineer
With Administrative Experience in the Design of Steam Electric Stations
Preferably Between 35 and 45 Years of Age
LARGE EASTERN UTILITY
All Replies Strictly Confidential
P-3323, Power
330 West 42nd Street, New York 18, N. Y.

MECHANICAL DESIGN ENGINEER
Major Construction Division of Indiana Utility requires a Mechanical and Structural Designer for steam stations capable of approving drawings, specifications, contracts, and requisitioning equipment. State education and experience, salary desired, and availability.
P-5172, Power
520 North Michigan Ave., Chicago 11, Ill.

POSITIONS VACANT

GRADUATE ENGINEER as assistant plant engineer in large progressive tannery located in Milwaukee, Wisconsin. Position offers distinct possibilities for young man with process improvement, material handling, and plant layout experience. Give age, experience, education and salary expected. P-5220, Power.

DRAFTSMAN, DESIGNING. Exceptional opportunity for excellent craftsman with design sense and experience in plant layout, piping, and process pressure vessels. Location, Central Michigan. State complete qualifications and experience in application. P-5053, Power.

HELP WANTED. Old firm located in the Middle Eastern States needs high-pressure boiler operators. Good opportunity to learn and advance. Young men with some experience firing high-pressure boilers. Technical training in steam engineering will be helpful. Will consider waiving extensive experience if other qualifications are satisfactory. Write P-5048, Power, giving age, detail of training, experience, and other qualifications.

WANTED. GRADUATE Electrical Engineer with experience in design, layout and maintaining electrical equipment and power distribution. Must be able to plan and direct the engineering of electrical work in plant with 2,300 volt, 5,000 KW generation. Middle Eastern location. P-5090, Power.

(Continued on page 251)

To
EMPLOYERS
who advertise
for MEN:

Frequently, when there are many applicants for a position, only the most promising letters are acknowledged. The other applicants never know whether their letters reached a prospective employer or not. These men often become discouraged, will not respond to future advertisements and even question their bona fide character.

Every advertisement printed in the Searchlight Section is duly authorized.

You can help keep our readers interested and get better returns to your advertising in this section if you acknowledge each reply — in plain envelopes, if you wish.

Classified Advertising Division

McGRAW-HILL PUBLISHING COMPANY, INC.

"Put yourself in his place."

POSITIONS VACANT
(Continued from page 250)

WANTED, SEVERAL engineering graduates, under 35, by large industrial fire prevention organization maintained by leading insurance group. Permanent position. Periodic inspections and special consulting service for leading industrial plants. Thorough training. P-4801, Power.

ASST. SUPT. — Mechanical — Steam-Electric Power Station. Must be experienced all phases mechanical operation and maintenance boilers, turbines, condensers, pumps, etc., accent on maintenance. Capable detailed supervision experienced workmen. Must be well grounded technically. Not necessarily a degree. Give full outline education, work and personal references, salary expected. All communications confidential. P-5171, Power.

RESIDENT MECHANICAL Engineer. A permanent and prominent organization requires the service of an experienced mechanical engineer to design electrical, plumbing, heating, ventilating, and air conditioning systems for buildings of residential, store and hotel character, including supervision of the operation and maintenance of existing electrical and mechanical installation of buildings. Pleasant working conditions. Salary commensurate with ability and experience. Give complete resume in first letter. Address your reply care this publication. P-4995, Power.

MECHANICAL ENGINEER to assume full responsibility for operations and maintenance of a goodly sized hospital, including power plant. Location is in attractive portion of a large Ohio city. Engineering degree with minimum of five years experience required. Salary open. Four-room apartment if desired. P-4982, Power.

ESTIMATOR AND Field Superintendents—Familiar with heating and plumbing work and outside sewer and water distribution systems. Advise experience, education and salary expected. P-5097, Power.

SELLING OPPORTUNITY OFFERED

SALES ENGINEER. Power Chemicals of large chemical manufacturing organization has openings for representatives in all sections of the United States for sale of industrial water treatments—prefer men with experience or suitable chemical background. Salary, expenses and bonus arrangement. Send full particulars for interview. All replies confidential. E. F. Drew & Co., Inc., 15 East 26th St., New York 10, N. Y.

EMPLOYMENT SERVICES

SALARIED POSITIONS $3,500-$35,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (38 years recognized standing and reputation). The procedure, of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 270 Dun Bldg., Buffalo 2, N. Y.

SALARIED PERSONEL, $3,000-$25,000. This confidential service established 1927, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

POSITION WANTED

MECHANICAL ENGINEER, 25, married, desires position as understudy to maintenance or operating engineer. 2 yrs. experience in sales doing sales, maintenance and installations; 1 yr. drafting. Reply to PW-5217, Power.

MR. EXECUTIVE: Your design headaches are cheerfully traded for a solid place on your staff say as a project engineer, by a man with over 20 years of "Know-how" raring to go places with you. PW-5188, Power.

BUSINESS OPPORTUNITY

Power Plant
and Franchise for sale, small midwestern town. BO-5069, Power.

DISMANTLING?

Boilers, Engines, Generators, Etc. dismantled & removed. Complete Plants purchased, dismantled and removed anywhere in the East.

Men — Tools — Insurance
30 yrs. experience.

"We can dismantle anything made of metal"

G. M. LINDER CO.
Plant Dismantlers & Contractors
40-18 216th St., Bayside, N. Y.
Tel. Bayside 9-2121
(day or night)

SUBJECT SALE

16 brand new

FAIRBANKS MORSE MOTORS

Type 2ZAK Frame 6095, 3 HP 3 Ph, 60 Cy. 1730 RPM, 220/440 Volt, 9.6 4.8 amp, 24 hour duty, synchronous, ball bearing.

16 Manual motor starting switches CR 1062, 3 ED, AC expansion proof, dust and water tight.

FS-5072, Power
330 West 42nd Street, New York 18, N. Y.

FOR SALE—TWO

STEAM ENGINE GENERATORS

1—Harrisburg Foundry & Machine 22 x 28 operating 150# steam 5# B.P.

1—Erie Ball Engine Co. 22 x 30 operating 150# steam 5# B.P.

Each direct connected to General Electric D.C. Generators Type LD-12, 300KW, 240V, 2 wire, 35°C Rise.

Both in excellent running condition complete with switchboard.

FS-5178, Power
330 West 42nd Street, New York 18, N. Y.

WANTED

—TRANSFORMERS—

TRANSFORMERS WANTED

in operating condition or burnt out. Mail us list giving complete nameplate data and stating condition.

We Rewind, Repair and Redesign all Makes and Sizes
ALL TRANSFORMERS GUARANTEED FOR ONE YEAR

THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
MARIEMONT Since 1912 CINCINNATI 27, OHIO

WANTED

COMBUSTION SALES ENGINEER

to sell COKAL HAND STOKERS. Standard of the World for 30 years. Burns *all* Grades and Sizes of Bituminous Coal. For Active and for Standby Plants. A Small Investment—A Large Return in Security. Address—Sales Manager, P.O. Box 127, Evansville, Ind.

WANTED MANUFACTURER'S REPRESENTATIVE

to contact coal-burning industrial institutions to distribute Today's Coal Bill Reducer (for high pressure boilers) which pays for itself quickly. Sales and combustion engineering experience desirable.
Address — P. O. Box 1367 — Chicago, Ill.

AGENTS WANTED

SHEAR-KLEAN Grate Engineers have open territory for live wire Sales Engineers on famous SHEAR-KLEAN Grates. Suitable for all types of boilers. Write—

P. O. Box 656, Evansville, Indiana.

WANTED

1—375 KVA 240 Volt A.C. 60 cycle *Generator* direct connected to a uniflow, non condensing engine 150 psi ISP, 0 back pressure. State specification, manufacturer, condition and price.

3—100 KVA 7200/2400 120/240 volt OICS *Distribution Outside Transformer*. State manufacturer, condition and price.

Natatorium Laundry Company
428 HEMPHILL FORT WORTH, TEXAS

WANTED FOR CASH

1—FREQUENCY CHANGER SET CONSISTING OF: 2000 to 3000 KVA, 3 phase, 60 cycle, 300 RPM alternating current generator direct connected to a 3 phase, 25 cycle synchronous motor complete with exciters, and all control panels with instruments—2400 or 7200 volts preferred.

Furnish complete specifications, serial numbers, condition and price.

W-4993 Power
520 North Michigan Ave., Chicago 11, Ill.

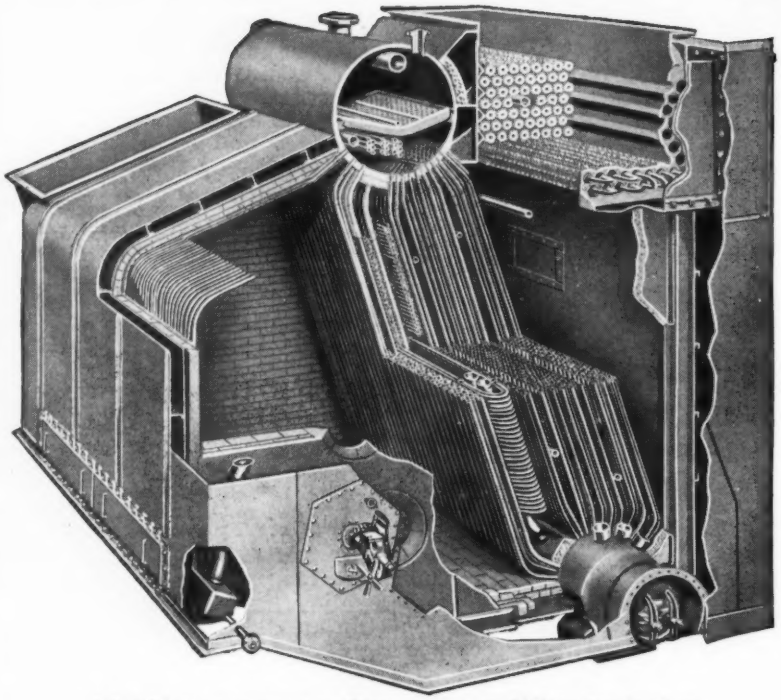
FOR EVERY
BUSINESS WANT
"Think Searchlight First"

Air Compressors Wanted

Horizontal Water Cooled—Any size
also 2 Stage portable units

L. W. BAUER
North Bergen, N. J.

POWER PLANT MACHINERY



60,000# steam per Hour Foster Wheeler Boiler

PACKAGE TYPE BOILERS

60,000# steam per hour Foster Wheeler steel — encased boilers, modified "D" type, two drum, bent tube, 435# pressure, 750 deg. total temperature.

Boilers equipped with waterwalls, superheaters, economizers, Vulcan soot blowers, Swartwout feedwater regulators and Todd oil burners.

The above boilers can be shipped intact on underslung railroad flat cars. They were built new for the Government in 1943 and are in excellent condition. They are still connected up as in operation and are equipped with interconnecting piping, valves and fittings.

CONDENSING TURBO UNITS

3 phase, 60 cycle

2250 KVA G.E. 3 phase 60 cycle 480/600/2300/4150 volts, 3600 RPM 10-stage, 250/.400# steam pressure, 725 deg. TT. Equipped with air cooler, surface condenser and auxiliaries. New 1943.

3125 KVA G. E. 2300 v., 165# steam
3125 KVA Wstgh. 600 v., 250# steam
1875 KVA G. E. 600 v., 235# steam
1875 KVA G. E. 2300 v., 250# steam
1563 KVA G. E. 2300 v., 250/400# steam
1250 KVA G. E. 4150 v., 200# steam
1250 KVA Wstgh. 2300 v., 425# steam
625 KVA G. E. 2300 v., 150# steam
375 KVA G. E. 2300 v., 175# steam
375 KVA Allis 480 v., 190# steam
150 KVA (4) G. E. 480 v., 360# steam

EXTRACTION TURBO UNITS

5000 KVA Wstgh. 13800 volts, 600# steam, 135# extraction
1250 KVA G. E. 480 volts, 200# steam, 15# extraction
940 KVA Wstgh. 600 volts, 150# steam, 20# extraction
937 KVA Wstgh. 480 volts, 150# steam, 10# extraction

UNIFLOW UNITS

3 phase, 60 cycle

1000 KVA Skinner, 480 volts, 160# steam, 7# exhaust
750 KVA Skinner, (vertical) 480 volts, 150# steam, 5# exhaust
625 KVA Skinner, 2300 volts, 150# steam, 5# exhaust
375 KVA Skinner, 2300 volts, 150# steam, 5# exhaust

SYNCHRONOUS MOTORS

6—3500 HP G.E. totally enclosed synchronous motors, 3 phase, 60 cycle, 4000/2300/550/440 volts, 257 RPM

DIESEL UNITS

3 phase, 60 cycle

1250 KVA Fairbanks Morse 4160/2400/-480volts
1150 KVA Superior 2300 volts
875 KVA DeLaVergne 2300 volts
470 KVA Nordberg 2300 volts
282 KVA General Motors 240 volts
187 KVA (3) Fairbanks Morse 2400 volts

MOTOR GENERATOR SETS

3 phase, 60 cycle

1800 KW General Electric 125/250 volts 3-wire 600 RPM direct connected 2500 HP 85% P.F. General Electric synchronous motor, 3 phase 60 cycle 4000 volts.

1000 KW G. E. 250 v., D.C., 4600 v., A.C.
500 KW G. E. 250 v., D.C., 440 v., A.C.
300 KW Allis 250 v., D.C., 2300 v., A.C.

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. Telephone: MAin 9514 CLEVELAND 14, OHIO

This Seal ...tells you what you buy is GOOD EQUIPMENT!

GUARANTEED GOOD BECAUSE REBUILT AND TESTED UNDER SUPERVISION OF

HEMPHILL ELECTRICAL ENGINEERS

TRANSFORMERS

1—Auto, 500 KVA, Packard, 3 phase, 4150 volts, 2—2300 volts.
3—300 KVA, Pitts., 2300 V. Pri., 115/230 V. Sec.
3—300 KVA, G.E., type H, 2300 V Pri, 115/230 V. Sec.
300 KVA, Pitts., 7800-440 v.
205 KVA, Whse., 2 phase, 2300 to 3 ph., 4150 autp
200 KVA, Pitts., 4000 v.—110/220
100 KVA, Pitts., 1375/2750 v.—110/220
3—100 KVA, Wagners, 240/120 v.—120 v.
3—100 KVA, Newark, 440 v., 2 phase to 220 v., 3 phase
1—100 KVA, Whse., 13,800 v. to 250 v.
3— 75 KVA, G.E., 2400 v.—120/240
6— 50 KVA, Whse., 2400 v.—120/240
6— 50 KVA, Whse., 13,800 v. to 125 v. or 250 v.
6— 50 KVA, Whse., 6900 v. to 125 v. or 250 v.

A. C. GENERATORS

2500 KVA, Whse., Syn. Cond., 720 RPM, 2400 v.
500 KW, .8 P.F., 3600 RPM, ATB, 600 v.
320 KW, Allis, 450 RPM, 480 v.
240 KW, G.E., ATB, 600 RPM, 600 v.
200 KVA, Allis, 3600 RPM, 240 volt.
200 KVA, Whse., 600 RPM, 240 v.
180 KW, Whse., 514 RPM, 550 v.
165 KW, El. Merch., 514 RPM, 240 v.
100 KW, G.E. ATB, 600 RPM, 240 v.
75 KW, Whse., 900 RPM, 220 v.
62½ KW. Allis, 3600 RPM, 220 v.
7— 50 KVA, Whse., 900 RPM, 220 v.
50 KVA, Whse., 1200 RPM, 220 v.
3— 35 KW, Columbia, 1200 RPM, 240 v.
1— 31.3 KVA, America, 1200 RPM, 120/208
15 KW Star, 1800 RPM, 220/440
12.5 KVA, Whse., 1200 RPM, 240 v.

TURBINE BLOWERS

1—Spencer Turbine Blower, 1000 cubic feet, 30 oz. pressure with a 15 H.P., 3600 RPM, General Electric Type FT, 200 volt motor.

1—Ballmore, 550 cubic feet, 7 inch vacuum, with a 20 H.P. 3600 RPM, General Electric, Type K, 220 volt, 3 phase motor.

MOTORS, 3 Phase, 60 Cycle

SQUIRREL CAGE

750 H.P., General Electric, 750 RPM, 6600 v., 25 cycle
450 H.P., Ridgeway, 900 RPM, 2200 volts
125 H.P., G.E., KF, 1750 RPM, 2200 v.
125 H.P., U.S., 1200 RPM, Vert., 220 volts
150 H.P., G.E., KT, 1200 RPM, Vert., 220 volts
75 H.P., West., CS, 1750 RPM, 440 volts
60 H.P., Whse., 900 RPM, Vert., 2200 volts
60 H.P., Whse., 900 RPM, 440 volts
2— 40 H.P., G. E., 900 RPM, 220 volts
35 H.P., Whse., 1200 RPM, CS, 2200 volts
35 G.E., 600 RPM, 550 volts
25 H.P., U.S., 1800/1200/900/600, 440 volt
2— 10 H.P., Whse., Gear 440 RPM, 440 volt

MOTORS, 3 Phase, 60 Cycle

SLIP RING

1—2500 H.P., G.E., Mt. 257 RPM, 6600 V.
1— 500 H.P., G.E., M, 1200 RPM, 2300 V.
450 H.P., G.E., 425 RPM, ITC, 440 volts, 25 cycle
200 H.P., G.E., MT, 440 volt, BB, 725 RPM
100 H.P., G.E., IM, 440 volt, 25 cycle, 720 RPM
75 HP., Whse., CW, 720 RPM, 440 volt
75 H.P., G.E., MT, 1200 RPM, Vert.
50 H.P., G.E., MT, 600 RPM, 220 volt
2— 50 H.P., Whse., CW, 900 RPM, 220 volts
40 H.P., Cont., 1200 RPM, JA85, 220 volt
40 H.P., G.E., 1200 RPM, MT, 220 volt
40 H.P., G.E., 900 RPM, 220 Volt, ITC
40 H.P., G.E., 900 RPM, MT, 900 RPM, 220 volt
40 H.P., G.E., 900 RPM, 2200 volt

LARGE STOCK OF

D.C. MOTORS AND GENERATORS

SYNCHRONOUS MOTORS

4—200/100 H.P., Whse., 720/360 RPM, 4150 V
200 H.P., Whse., 600 RPM, 240v.
150 H.P., G.E., 900 RPM, 4150 v., TS
75 H.P., G.E., 1200 RPM, 440 v.
70 H.P., Elect. Mach., 180 RPM, 220 v.
40 H.P., Whse., 1800 RPM, 220 v.
35 H.P., G.E., 1200 RPM, 2200 v.
20 H.P., Whse., 1800 RPM, 220 v.

MOTOR GEN. SETS

1—500 KW, G.E., 250 V, 900 RPM, 2300 V. Syn.
1—500 KW, G.E., 575 V, 900 RPM, 2300 V. Syn.
1—300 KW, G.E., 250 V, 1200 RPM, 2300 V, Slip Ring
1—200 KW, Whse., Rot. Con., 2300 V. A.C., 575 V. D.C.
125 KW, CW, 125 v., 1200 RPM, 2300 v. sq. cage
100 KW, El Mach., 125 v., 1200 RPM, 4150 v., syn.
100 KW, G.E., 230 v., 900 RPM, 4150 v. syn.
2— 75 KW, G.E., 125 v., 1200 RPM, 220/440 v.
6— 75 KW, G.E., 60 v., 1200 RPM, 220/440 v.
50 KW, Ridgeway, 550 v., 1200 RPM, 220 v.
25 KW, G.E., AT1, 1800 RPM, 40 HP, 1800 RPM, 230 v.

PLATING M. G. SETS

250 amp., G.E., 5/6 volt, 220 v.
500 Amp., Hansen Van Winkle, 24 volt, 220/440 v.
2500 Amp., Chandeysson, 6/12 v., 400 RPM, Syn., 440 v.
3000 Amp., Chandeysson, 6/12, 400 RPM, syn., 440 v.

ENGINE GEN. SETS

150 KVA, G.E., Ames Uniflow, 220 v., 3 ph., non. cond.
2— 5 KW, Gasoline, Hobart, 1800 RPM, 120 v., 1 ph. cont. engines 200/275 v., gasoline Van Blerck. 8 cyl, 1500 RPM, grav. 900 RPM

TURBO. GEN. SETS

625 KVA, Westinghouse, 2400 v., 3 phase, non-cond
300 KW, G.E., ATB, 240 v., 3 ph., cond.
60 KW, Whse., 120 v., D.C., cond.
50 KW, Whse., 120 v., D.C., cond.
30 KW, Allis, 120 v., D.C., Terry non cond.

JLHCo

THIS SEAL IS YOUR GUARANTEE

"FOR POWER"

J.L. HEMPHILL & CO.

1604 53rd STREET, NORTH BERGEN, N. J.

PHONE NEW YORK—LONGACRE 5-3227

PHONE NEW JERSEY—UNION 3-2600

HERE'S WHY WE CAN SAY "Successful Operation GUARANTEED"

WE OWN EVERYTHING ON THIS PAGE
WE BUY THE BEST

IT'S ALL BELYEA

TRADE RE-NU-BILT BELYEA MOTORS MARK

RE-NU-BILT EQUIPMENT

REBUILT IN ACCORDANCE WITH N. I. S. A. STANDARDS

SPECIAL

2—3 Unit—200 KW—Syn M-G Set—440 V., 3 ph. 60 cy., Motor with 2—100 KW., 250 V. Gen.—Also 4—125 HP, 1750 RPM, 250 V. D.C. Motors—Reduced Voltage, A.C. Starter and Amplidyne Control for D.C. Motors. Also Exciter M-G.

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	1500	G.E.	600	600	2300/4150
1	1500	G.E.	360	275	2200/4400
1	1000	G.E.	720	600	4000
1	1000	West.	514	250	4150
1	1000	Al. Ch.	720	450	2300
2	500	G.E.	720	600	2300/4150
1	500	G.E.	720	600	6600/13200
1	500	G.E.	720	600	4400
1	500	G.E.	720	125	6600/13200
1	400	Whse.	1200	250	440/2300
1	350	G.E.	900	125	4150
1	300	G.E.	720	550	2300/4000
1	250	G.E.	720	275	2300/4000
1	250	G.E.	1200	250	440
1	150	Cr. Wh.	1200	250	440
1	100	G.E.	1700	125	220
4	90	G.E.	1800	60	220/440
1	75	Cr. Wh.	1160	250	220/440
1	75	G.E.	1180	125	2300/4000
1	60	Cr. Wh.	1750	250	220/440
1	60	Whse.	1150	60	220/440
1	50	G.E.	1145	125	220
2	50	G.E.	1200	250	2200
1	50	G.E.	1145	125	220
1	48 (30)	G.E.	1750	60	440
1	45	G.E.	1200	60	220
2	35	G.E.	1200	120	440
1	25	Whse.	1750	125	2300

FREQUENCY CHANGER SETS

1—1000 KW—GE—2 Unit—3 Brg. Consisting of—1400 HP—4400 V, 3 ph. 25 Cy. Motor and 1000 KW—2300 V.—8 ph. 58.3 cycle gen. with exciter (Gen can be reconnected for 800 KW 3 ph.)

1—320 KW—GE—2 Unit—3 Brg. consisting of 600 HP—440 V., 3 ph. 60 cy., 8 pf. Syn. Motor and 400 KVA .8 pf. type AT—3 ph. 120 cy. 720 volt AC generator with direct connected exciter.

5—	40	Rel.	385-T	230	400/500

These units are semi-enclosed, b. brg. motors and part of complete V-S Drive with 40 KW Ind. M.G. Set with 220/440 v. A. C. Motor; exciter and complete control equipment. M. G. and control in steel enclosure.

D.C. MOTORS

	HP	Make	Type	Volts	Speed
6—	1500	Whse.		525	600
1—	1200	Whse.		600	425
1—	800/1000	Whse.		450	600/720
1—	765	G.E.	MPC	500	1045/1350
1—	700	G.E.	MCF	600	150/525
1—	650	G.E.	MPC	250	115/145
1—	300/400	G.E.	DYNA	250	1325/2500
1—	375	G.E.	MPC	230	450/900
1—	335	Whse.	MQ	250	300/900
1—	250	G.E.	MPC	230	400/500
1—	230	Al. Ch.		230	700
1—	80/180	G.E.	MPC	240	400/1000
1—	150	G.E.	MPC	230	250/450
1—	150	Cr. Wh.	CCM	230	300/1050
10—	150	Cr. Wh.	83H	230	890
1—	150	Cr. Wh.	CMC-65H	230	1150
2—	125	G.E.	CQ-1832	230	625
1—	125	El. Dy.	30S	230	750/1500
1—	115	Cr. Wh.	JHL	230	1200
4—	101	Whse.	SK	230	485/950
1—	100	Whse.	SK-182	230	300/1200
1—	50/100	G.E.	CD-175	230	365/730
1—	80	El. Dy.	30S	230	500/1500
1—	80	Whse.	SK-180	230	450/1200
2—	75	El. Dy.	25-SL	230	750/1750
3—	60/75	Whse.	SK-200	115	300/700
8—	75	Cr. Wh.	53-H	230	860
1—	75	Cr. Wh.	CMC	230	1150/1760
1—	60	El. Dy.	25-S	230	525/1050
2—	60	Whse.	Hoist.	230	415
1—	60	Whse.	SK	230	500/1000
1—	60	Whse.	SK-131	230	500/1500
1—	60	El. Dy.	25S	230	750/1500
2—	50	G.E.	RCP-31B	230	1700
1—	50	G.E.	RC-34	230	1050
1—	50	G.E.	RF-16	230	500/1500
1—	50	Whse.	SK-131	230	500/1500
4—	50	Whse.	Hoist	230	400
1—	50	Whse.	SK-153	230	690/1035
1—	50	G.E.	CD-123	230	675/1035
1—	50	Whse.	SK-170	230	350/1050
1—	50	Cr. Wh.	CMC-8014	230	380/750
1—	50	Rel.	461-T	230	250/1000

ROTARY CONVERTERS

60 Cycle

KW	Make	Speed	D.C. Volts	A.C. Volts
1—1500	Whse.	720	600	2300
1—1000	G.E.	900	600	11000
1—1000	Whse.	900	600	11000
1— 750	Whse.	900	600	13200
1— 750	Whse.	720	250	6600
1— 500	G.E.	900	250	2300

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
1	4000	G.E.	TSC	2400/4800	900
1	500	G.E.	ATI	480	900

SPECIAL—MERCURY ARC RECTIFIERS

1—750 KW—GE—Type RHW—6 Anode 575 V., D.C. Form C with 2300 V., 60 cycle transformer and switching equipment.

1—500 KW—GE—Type RHW—6 Anode 575 V., D. C. Form 8 with 2300 V., 60 cycle transformer and switching equipment.

A.C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

	HP	Make	Type	Volts	Speed
2—	3500	G.E.	TS	2300	257
1—	2100	G.E.	ATI	4600	510
2—	2000	Whse.		2300	120
1—	1000	Whse.		2300	189½
1—	900	Al. Ch.	(New)	2200	150
1—	500	G.E.	ATI	480	900
2—	500	G.E.	TS	4150	600
1—	450	Whse.		2300	1285
2—	450	Whse.		2300	1800
2—	350	G.E.	TS	2200	150
1—	320	G.E.	ATI	2300	600
1—	300	G.E.	ATI	440	720
1—	150	G.E.	TS-7558	2200	720
1—	145	G.E.	ATI	550	720
1—	100	Whse.		550	600
1—	85	G.E.	TS	440	1800

SLIP RING

1—1000	Whse.	CW	2300	700
1— 900	G.E.	IM	2300	880
2— 500	G.E.	IP	550	505
1— 350	G.E.	MT-442Y	2200/4000	253
1— 300	Whse.	CW	440	1750
2— 300	Al. Ch.	3 Brg.	2300	505
1— 250	G.E.	MT-563Y	550	900
1— 200	G.E.	IM	440/550	435
1— 250	G.E.	MT-424Y	4000	257
1— 250	G.E.	MT-559S	2200	1800
2— 100	G.E.	IM-16	2200	435
1— 75	Whse.	CW-761	2300	1750
1— 75	F.M.	By-H16B	2300	1750
3— 50	Whse.	CI-638A	220	870
2— 50	Whse.	CIW-504	440	870
1— 50	Rel.	1XM	2300	880
1— 50	G.E.	MT-352	550	600

SQUIRREL CAGE

1—	250	West.	CS-7111	2200	3530
1—	250	G.E.	IK	440	600
1—	250	G.E.	KT-559	440	1800
1—	200	(New) G.E.	K	2300	1200
1—	200	G.E.	IK	550	865
1—	125	(New) G.E.	KF-TEFC	440	1190
1—	100	G.E.	IK-Vert.	2300	450
1—	75	G.E.	K	2200	1200
1—	75	Rel.	C-5085	220	890/1775
1—	50	G.E.	KF-405S	220/440	3550
2—	50	Whse.	CS	220	870
1—	50	G.E.	KT-327	2200	1750

Turbo Generators

See our advertisement on page 270

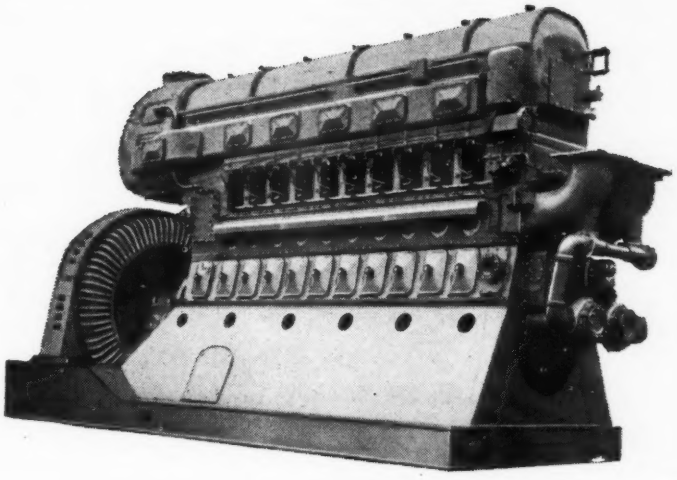
Remember this name **BELYEA COMPANY, INC.**

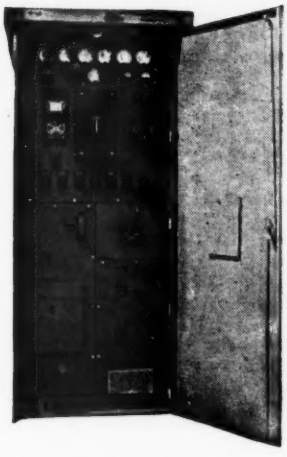
OUR 40 YEAR REPUTATION IS YOUR PROTECTION

Main Office and Shop
43 HOWELL ST., JERSEY CITY 6, N. J.
Phone — Journal Square 2-3334
Also N. Y. City Line — Rector 2-7150

ENGINEERED AGSCO DIESEL POWER

COMPLETE PLANTS IMMEDIATE DELIVERY





1250 KVA FAIRBANKS MORSE DIESEL GENERATING SET, MODEL 38D8⅛ WITH *NEW* ELECTRIC MACHINERY MANUFACTURING CO. ALTERNATOR, 3 PHASE, 60 CYCLE, 2300 VOLTS.

Unit is offered complete with switchboard and all auxiliaries and accessories.

OTHER OFFERINGS READY FOR PROMPT SHIPMENT

50 AND 60 CYCLE DIESEL GENERATING UNITS

KVA	Make	HP	Model	RPM
*1250	General Motors	1600	16-278A	720
*1250	Fairbanks Morse	1600	38D8⅛	720
1250	Nelseco	1500	6M1-53	300
1000	Fairbanks Morse	1200	38D8⅛	600
*900	General Motors	1200	12-567	720
750	General Motors	900	12-567	600
*625	General Motors	750	8-278A	720
400	Ingersoll Rand	460	S	600
375	Baldwin	448	VO-6	400
375	Worthington	450	DH-6	450
375	General Motors	450	8-268A	1200
312	Cooper Bessemer	375	FSN-6	900
312	General Motors	450	8-268A	1200
300	Fairbanks Morse	360	Y	257
250	General Motors	350	8-268A	1200
156	Fairbanks Morse	150	32E14	300
125	Murphy	150	ME-650	1200
125	General Motors	150	3-268A	1200
100	Buckeye	150	E	325
94	General Motors	160	6045A	1800
62	International Harvester	76	UD-18	1200
42	Fairbanks Morse	110	32D	360
25	Lister	30	2 7/3	1200

*** THESE UNITS ARE AVAILABLE AS PORTABLE SETS**

Write for Bulletins

DIESEL ENGINES

AG **SCHOONMAKER CO INC.**

Business Est. 1898

50 CHURCH STREET NEW YORK 7, NEW YORK

Cable Address: AGSCOMACH PHONE: Digby 9-4350

DIESEL POWER

POWER PLANT MACHINERY

AVAILABLE IMMEDIATE DELIVERY

TURBINE-GENERATOR UNITS
3 Phase, 60 Cycle

3125 KVA Westg. condensing 200 lbs. pressure, 600 volts, 3600 RPM complete exciter, surface condenser.
1875 KVA G.E. condensing 250 lbs. pressure, 2300 volts, 3600 RPM complete surface condenser.
1563 KVA Allis condensing 200 lbs. pressure, 600 volts, 3600 RPM complete exciter, condenser, switchboard.
1563 KVA G.E. condensing, 300 to 400 lbs. pressure, 2300 volts, 3600 RPM complete exciter, surface condenser.
1250 KVA Allis automatic extraction condensing 300 lbs., 25 lbs. bleeder pressure, 480 volts, 3600 RPM complete exciter, switchboard and condenser.
1250 KVA G.E. condensing, 250 lbs. pressure, 600 volts, 3600 RPM complete shaft exciter, switchboard and surface condenser.
1250 KVA G.E. condensing, 200 lbs. pressure, 4150 volts, 3600 RPM complete exciter, condenser, panel.
625 KVA G.E. condensing, 150-175 lbs. pressure, 480 volts, 3600 RPM complete exciter, switchboard, surface condenser.
625 KVA G.E. non-condensing 150 lbs. pressure, 15 lbs. back, 2300 volts, 3600 RPM complete exciter, panel.
500 KVA Westg. non-condensing 150 to 175 lbs. pressure, 10 lbs. gauge, 240 v. complete exciter, switchboard instruments.
375 KVA (2) G.E. condensing 400 lbs. pressure, 450 volts, each complete exciter, switchboard, surface condenser.
375 KVA G.E. condensing, 125 lbs. pressure, 2300 volts, 3600 RPM complete surface condenser and panel.
125 KVA Westg. non-condensing, 175 to 200 lbs. pressure, 0-10 lbs. back, 240 volts with exciter, panel.
125 KVA G. E. non-condensing, 175 to 200 lbs. pressure, 10 lbs. gauge back, 2300 volts, 3600 RPM complete.
100 KVA Westg. non-condensing, 125 to 150 lbs. pressure, 10 lbs. gauge back, 2400/600 volts, 3600 RPM.

ENGINE-GENERATOR UNITS
ALTERNATING CURRENT—3 phase, 60 cycle

750 KVA Westg. 440 volts, 164 RPM generator direct connected to 22"x32" Nordberg Unaflow non-condensing engine, 150 to 200 lbs. pressure, 10 to 20 lbs. gauge back.
500 KVA Westg. 460 volts, 164 RPM generator direct connected to 26"x28" Skinner Unaflow non-condensing engine, 140 to 160 lbs. pressure, 0 to 10 lbs. gauge back.
375 KVA Fairbanks-Morse, 240 volts, 300 RPM generator direct connected to 450 HP, 300 RPM, 6 cylinder, Model 32-E-14 full Diesel engine complete with switchboard.
312 KVA G.E. 480 volts, 180 RPM generator direct connected to 24"20" Skinner Universal Unaflow engine, 175 to 200 lbs. pressure.
200 KVA Crocker-Wheeler, 240 volts, 400 RPM generator direct connected to Ames Vertical Unaflow engine, 110 to 125 lbs. pressure, 5 lbs. gauge back.

ENGINE-GENERATOR UNITS
DIRECT CURRENT

325 KW, 35°, 400 KW Maximum, Crocker Wheeler 125 volt, 300 RPM Generator direct connected to Skinner Vertical Unaflow Engine.
250 KW Crocker-Wheeler, 250 volt, 257 RPM generator direct connected to 360 HP, 6 cylinder late type Fairbanks-Morse full Diesel engine—complete.
200 KW (3) New General Electric 120 volt Marine type turbine generator units.
200 KW Burke 3-wire, 250 volt, 360 RPM generator direct connected Ames 4 cylinder vertical Unaflow non-condensing engine, 150 lbs. pressure complete switchboard.
200 KW G.E. 125 volt, 200 RPM generator direct connected to a Skinner Unaflow non-condensing engine.
100 KW (6) Delco 3-wire, 250 volt generator direct connected to 150 HP, 1200 RPM, 8 cylinder Superior Diesel engine complete with switchboard.
75 KW Allis Chalmers-Terry, 125 volts, 2400 RPM 150 lbs. pressure non-condensing turbine generator unit.
60 KW (3) new Westinghouse 120 volt Marine type turbine generator units.
15 KW Crocker-Wheeler, 125 volts, 410 RPM generator direct connected to an American Blower vertical engine.

MOTOR GENERATOR SETS

1500 KW Allis-Chalmers 550/600 volts, 300 RPM direct current generator direct connected 2190 HP, 3 phase, 60 cycle, 4000/6600 volts synchronous motor.
500 KW Allis 250 volts, 1200 RPM direct current generator direct connected to 3 phase, 60 cycle, 4000/2300 volts 90-95% P.F. synchronous motor.
62½ KVA G.E. 3 phase, 60 cycle, 2300 volt, 1200 RPM alternator direct connected to 75 HP, 115 volt direct current motor.
50 KW Westg. 125 volt, 1200 RPM direct current generator direct connected to 75 HP, 3 phase, 60 cycle, 2300 volt induction motor.

SPECIALS

900 HP (2) Allis 3 phase, 60 cycle, 220 volts, 150 RPM synchronous motors.
250 HP (2) Ideal 3 phase, 60 cycle, 2200 volts, 450 RPM synchronous motors.
500 KVA Westgh. 3 phase, 60 cycle, 440/550 or 2300 volts, 514 RPM three bearing belted alternator.
200 KVA Westgh. 3 phase, 60 cycle, 2300 volt, 257 RPM engine type alternating current generator with direct connected shaft exciter and switchboard.
300 KVA G.E. type ATI, 2300/440 volts, 720 RPM generator.
5425 GPM Worthington 70′ head, 1800 RPM centrifugal pump direct connected to 125 HP G.E. 3 phase, 60 cycle, 2200 volt slip ring motor.
1— Allis-Chalmers jet condenser suitable for 2000 KW steam turbine-generator unit.
4400 sq. ft. two-pass Worthington surface condenser.
1250 sq. ft. Elliott surface condenser.
10 ton Capacity Brown hand operated traveling crane with 31′ 10″ span including 150′ of I-beams.

G.E. FREQUENCY CHANGER SET

1—360 KW 80% P.F.—450 KVA, type ATI, 60-62½ cycle, 2300 volts, 750 RPM alternating current generator direct connected to:
1—525 HP 80% P.F., type ATI, 3 phase, 25 cycle, 4000 volts, 750 RPM synchronous motor complete with switchboard.

Utilities Electrical Machinery Corporation
600 NATIONAL CITY BANK BLDG.
CLEVELAND 14, OHIO
WIRE OR PHONE
LONG DISTANCE 422

GLOW ELECTRIC CO

SQUIRREL CAGE MOTORS

HP	RPM	Volts	Make
750	900	6600	Wtg.-CS
350	514	440	GE-I
250	600	2300	Triumph
200	490	2200	GE
125	340	220	A-C
100	514	220	A-C
85	3600	2200	GE
75	720	2300	Wagner
75	360	220	GE-I
60	3600	2300	GE-KT
60	900	440	GE-KT
50	3600	440	R. & M.
50	900	220	GE
50	720	2300	Wtg.-CS
40	720	440	GE-KT
40	900	2300	Wtg.-CS
35	600	220	FT. Wayne
30	720	220	GE-HI
25	900	220	GE-FTR
25	720	220	Wagner
25	600	440	GE-I
25	900	440	GE
20*	1800	220/440	Wesche
20	900	440	Wtg.-CCL
20*	1800	220/440	Master
15	3600	220	GE-KT
15	1800	220	W-E
15*	1800	220/440	Master

ENCLOSED SQUIRREL CAGE

HP	RPM	Volts	Make
15	1200	220/440	Delco-TEFC-BB
7½*	1800	dual	Wagner-TEFC-BB
7½*	1800	dual	Master-TEFC-BB
7½	1200	dual	GE-Hi Slip-TEFC-BB
7½	1090	220/440	GE-KR, high slip
5*	1800	dual	Master-TEI C-BB
5	1800	220	Wagner TE-BB
5*	1200	dual	GE-TEFC-BB
3	3600	440	Wtg.-TE-BB
3	1800	dual	Delco-TEFC-BB
3	1200	dual	Rel-TEFC-BB
2	1800	dual	Delco-TEFC-BB
2	1200	220	GE-TE-BB
2	900	220	Wagner-TE-BB
1½	900	dual	Delco-TEFC-BB
1½	1800	dual	L. Al.-TE-BB
1½	1200	dual	Ref-TE-BB
1	3600	220	Haskins-TEFC
1	1800	dual	Master-TEFC-BB
1*	1800	dual	Delco-TE-BB
1*	1200	dual	Rel-TE-BB
¾	3600	4400	Delco-TE
¾	1800	dual	Wesche-TE-BB
½	3600	220	Ohio-TE-BB
½	1800	440	Wtg.-TE-BB
½*	1800	dual	Delco-TE-BB
½	1200	220	Cr. Wh.-TE
¼	3600	440	GE-TE
¼	1800	220	Del-o-TE-BB
¼	1800	440	Delco-TE-BB
¼	1800	440	Delco-TE

*New Motor

SLIP RING MOTORS

HP	RPM	Volts	Make
500	900	440	GE-3 Brg.
400	1200	2300	Al. Ch.
375	1800	2300	Al. Ch.
300	600	2200	GE
235	1860	220	GE-I
250	300	2300	Al. Ch.
75	360	220	GE-I-M
60	1800	dual	Al. Ch.
60	900	2300	Burke
60	900	220	Wesche
50	900	2300	Ridgeway
50	900	440	Wagner
50	720	440	Al. Ch.
40	1200	220	GE-MT-336
40	900	220	Wtg.-HF
40	720	2300	Wtg.-HF
40	720	220	Al. Ch.-ARY
40*	600	2300	Al. Ch.ARY
40	600	220	Al. Ch-ARY
40	450	220	Triumph-C
35	1200	220	Westgh.
35	900	220	Al. Ch.
35	900	2300	Ridgeway
35	720	220	GE-I
30	1800	2300	Wtg.-CW
30	1200	2300	Lincoln
30	900	220	GE-MT
30	900	2300	Ridgeway
30	720	220	GE-I
30	600	220	F. Morse-BV
30	1200	440	Wagner
25	1200	2300	Al. Ch-ANY
25	1200	220/440	Watson-KH
25	900	220	GE-MT
25	600	220	Watson
20	600	440	Westgh.
20	900	2300	GE-I

VERTICAL MOTORS

HP	RPM	Volts	Make
200	1200	440	Al. Ch.-SR
156	1200	2200	GE-I
150	1200	440	GE-Cage
125	1200	2300	Al. Ch.-Cage
100	1200	440	GE-Cage
75	1200	2200	GE-Cage
75	360	220	Ideal-Cage
60	1800	230 D.C.	GE
60*	1200	440	Al. Ch.-Cage
50	1800	440	GE-Cage
50	1200	2200	Wtg.-Cage
50	600	440	Al. Ch.-Cage
40	1800	220	GE-Cage
40	1700	230 D.C.	GE
40	1200	440	Wtg.-SR
40	1200	220	GE-Cage
40	950	230 D.C.	Wtg.
35	1800	440	GE-Cage
35	1200	2300	Al. Ch.-Cage
35	450	440	GE-Cage
30	1200	dual	Wtg.-Cage
25*	1550	230 D.C.	GE
25	1200	2200	GE-Cage

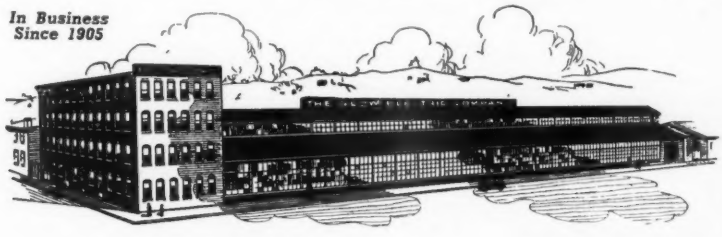
VERTICAL MOTORS—Cont'd.

HP	RPM	Volts	Make
25	850	230 D.C.	Wtg.
20*	1800	440	Al. Ch.
20*	1200	440	Al. Ch.-Cage
15*	1800	440	Al. Ch.-Cage
15	1750	110 D.C.	Wtg.
15	1150	230 D.C.	GE
12½	900	220	L. Al.-Cage
10	3400	230 D.C.	Wtg.
10	900	220	Wtg.-Cage
7½	1800	500 D.C.	Peerless
7½	900	440	Burke
7½	700	230 D.C.	GE
6	850	110 D.C.	Rel.
5	1400	230 D.C.	R. & M.
5	600	440	GE-Cage
4	1650	110 D.C.	Watson
3	1700	230 D.C.	Watson
3	1200	dual	Wtg.-Cage
3	900	440	Wtg.-Cage
3	600	dual	Wtg.-Cage
2	1800	230 D.C.	GE
2	1180	230 D.C.	Wtg.
2	900	220	GE-Cage
1	1200	220	GE-Cage

SYNCHRONOUS MOTORS

HP	RPM	Volts	Make
1015	500	2200	Wtg.-25 cycle
700	500	11000	GE-25 cycle
600	750	440	GE-25 cycle
500	600	4160	GE
350	750	4000	GE-25 cycle
250	225	2200	GE
250	225	440	GE
200	600	2300	GE
200	225	2200	Wtg.
115	164	208	GE
60	360	2200	GE
50	360	440	GE
30	900	440	Wagner
30	600	550	GE
30	450	dual	Wtg.
30	360	550	GE
30	327	220	E-M
25	1800	220	Wagner
25	450	220	E-M
25	300	220	Ideal
20	900	220	Wtg.
20	600	220	E-M
15	1800	220	Wagner
10	1800	220	Wagner
10	1200	220	Wagner
7½	1200	440	Wagner

In Business Since 1905



D. C. MOTORS

115 Volts

HP	RPM	Description
225	750	GE-MPC
60	1200	Star
35	975	Northern
35	610	GE
30	200/600	Sprague
25	1150	Triumph
25	750	GE
20	700	Triumph
20	500/1500	GE-RF11
20	400/1200	GE-RLC fr. 202A
15	1200	J. & L.
15	1100	Westgh. SK80L
15	1000	GE-CE
15	975	F-M
15*	725	Westgh.-S fr. 6
12	825	Northern
10*	950	Barriet, type E
10	700	J. & L.
10	650	J. & L. type CI
10	825	C-W-CCM
10	750	R & M type I-10
8	1500	Elect. Dynamic (series)
7½	3500	GE, type B
7½	1950	F-M, type CP
7½	1150	F-M, type CP
7½	975	Westgh.-S-3
7½	750	J. & L. type CI
7½	700	J. & L. type CI
7½	500/1500	Reliance-T-66T
7½	500	Westgh.-SK-BB
7½	170/220	Diehl-NG90
5	3600	Star-SF3-BB
5	1800	Wesche-BB
5	950	Swing-E-6
5	650/1950	Imperial-HVI
5	535/1070	C-W, type CMC

DC MOTORS—Cont'd.

5	400/1600	Northern-S
5	260	Diehl-BB
2½	575	GE-RC
2½	300/1200	Reliance-34T
2*	3500	American, type I-BB
2	1200	Westgh-SK
2	1000	Triumph
2	900	Watson-AW4B
2	500/2000	GE-CD
1½*	1750	Marathon
1½	600/1800	Watson-BW
1½	500/1500	GE-RA
1	1725	B-B, type DM
1	1150	GE-RC
1	920	Peerless
1	700	F-M, type TR
1	780/1560	C-W, type CM
1	600	Northern

*New Motor

D. C. GENERATORS

125 Volts

KW	RPM	Description
500	750	GE-MCF
300	1500	GE-CC
100	1000	WE-DLC
100	900	C-W-CCD
80	500	J. & L.-G
80	400	J. & L.-G
65	1100	W-E, type ELC-7
60	1200	Star, type SQ, single bearing
55	1000	GE-Type TD
35	1165	GE-DLC
31.25	1400	Westgh.-SK-single bearing
30	1200	Al. Ch., single bearing
25	1200	Westgh.-SK, single bearing

D. C. GENERATORS—Cont'd.

25	1100	GE-CL
25	600	Westgh.-SK, frame 150
25	300	W-E, type B
16.5	1200	Westgh. BB-DS-1
15	3600	GE-BF
15	1100	Al. Ch.
10*	1750	Westgh.-SK-43
9	1100	R. & M.
9	400	F-M
7½	3600	GE-BR
4	750	Westgh.-SK50L
2	1400	Westgh.
2	1200	Westgh.-SK

D. C. GENERATORS

230 Volts

KW	RPM	Description
400	1200	Westgh.
200	375	J. & L.-type K
175	450	Westgh.
125	1400	Westgh.-SK-130L
100	1500	Westgh.-SK-170
80	1050	W-E
60	1200	Ideal-DV
35	1800	GE-RC
35	970	GE-DLC
30	1200	Westgh.-SK, single bearing
30	300	Triumph
22½	765	Westgh.-SK
21	890	C & C, type SL
18	300	Burke
15	1800	L-A
15	350	Westgh.-SK
15	250	GE-CD
5	850	Triumph
1½	900	J. & L.-AI-7
1.2	1750	C-W-CCD

AC & DC MOTORS • GENERATORS • PUMPS
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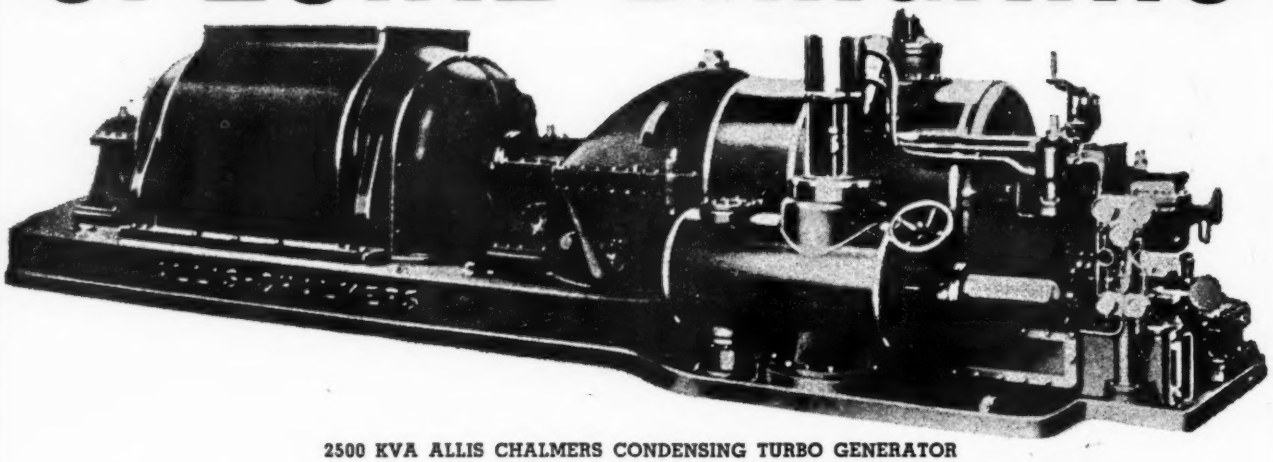
MOTOR GENERATOR SETS • ELECTRIC EQUIPMENT
STEAM ENGINE GEN. SETS • SLIP RING MOTORS

927 HARRIET ST.
PHONE MA. 3024
CINCINNATI 3, OHIO

SPECIAL BARGAINS



2500 KVA ALLIS CHALMERS CONDENSING TURBO GENERATOR

2 Specials

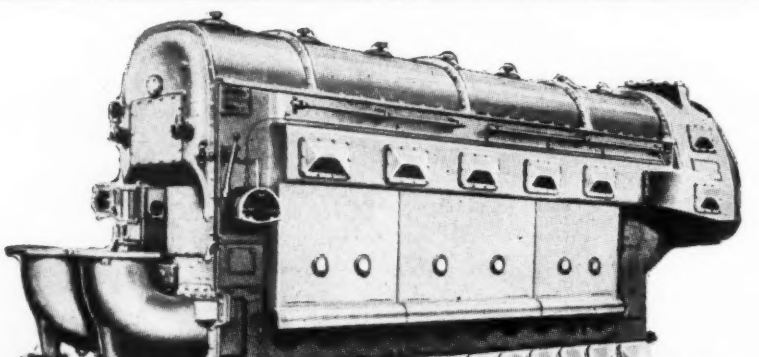
1—2000-KW., 80%-PF., 2500-KVA; NEW BLADING; NEW WINDINGS
1500-KW., 80%-PF., 1875-KVA.; NEW BLADING; NEW WINDINGS
New Condensers, Surface Type; New Auxiliaries
COMPLETE INSTALLATIONS; IMMEDIATE DELIVERY

OUR STOCK IS ONE OF THE LARGEST IN THE WORLD OF GOOD, USED AND NEW POWER PLANT EQUIPMENT

Send Us Your Specifications, Capacity, Voltage Steam-PSI

JULY SPECIALS

NEW 5000-KVA., G.E., 600#-psi, 750-FTT
Immediate Delivery
Aut. Extr. at 150#: Non-Cond. @ 25#
NEW—On Original Skids. Wire or Phone.
Also: 2—3750-KVA., G.E., New Surf. Condensers: 2—1875 KVA. West. Surf. C.
NEW, NEVER INSTALLED, G.E., 1075-KVA. Geared, 525#-psi. Delvy. Immediate
New 1075-KVA., G.E., 450#psi.-Immediate Delivery



8—FAIRBANKS-MORSE DIESEL ENGINES, MODEL 38D8-1/8; SAME AS NEW
NEW GENERATORS ORDERED: 60-DAY DELIVERY - COMPLETE UNITS.
4—400-HP. ENTERPRISE DIESEL ENGINES, NEW, NEVER UNBOXED; READY FOR EXPORT

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PUMPS . . . FANS . . . BLOWERS . . . SPEED REDUCERS

PATIAL LISTINGS—WRITE, WIRE OR PHONE YOUR REQUIREMENTS

SPECIAL—M-G SET—BARGAIN

300 H.P. Whse. synch. motor 3 ph. 25 cy. 440 V. coupled to 125 kva gen. 3/60/480 V. and 100 KW D.C. gen. type SK 125/250 V.

M-G SETS

KW	Mfr.	Input V	Output V
150	Cr. Wheeler*	220/440 AC	250 DC
105	Century b.b.	220/440 AC	70 DC
100	Gen. Elec.*	220/440 AC	125 DC
100	Whse.*	220/440 AC	125/250 DC
75	Star b.b.*	220/440 AC	250 DC
75	Star b.b.	240 DC	230/460 AC
75	Reliance	220/440 AC	550 DC
40	El. Prod.	220/440 AC	125 DC
35	Gen. Elec.	220/440 AC	48 DC
30	Marble Card	220/440 AC	60 DC
30	Elec. Prod.*	220/440 AC	50 DC
25	G. E. NEW	220/440 AC	125 DC
20	Whse.	220/440 AC	250 DC
15	Gen. Elec.	220/440 AC	125 DC
9	H.V.W. 1500 Amp.	220/440 AC	6/12 DC

*Synch. motor drive.

D. C. MOTORS

H.P.	Mfr.	Type	Volts	Speed
150	Cr. Wheeler b.b.	TEFC	230	890
100	Whse.	SK181	230	450/900
75	Cr. Wheeler b.b.	TEFC	230	850
75	Whse.	S13L	115	575
75	Gen. Elec.	BRC	115	1150
65	Gen. Elec.	C	230	375/750
60	Whse.	SK160	230	680
50	Whse.	SK160	230	550/1100
40	Reliance	310T	230	625/1200
35/50	Gen. Elec.	CD123	230	575/1150
30	Whse.	S-7	115	900
30	Whse.	SK160	230	350/1000
25	Whse.	SK100L	230	1100
25	Sprague dyna.	LC	230	750/2000
25	Chand'son (4)	C13	115	850
25	G.E. b.b. NEW	CDM93	115	1150
20	Gen. Elec.	RF12	230	400/1600
20	Whse.	SK93	230	1150
20	G.E. b.b. NEW	CDM83	115	1750
20	Gen. Elec.	RC11	115	1150
20	Reliance	T	230	850
20	Gen. Elec.	DLC	230	500/1500
15	Gen. Elec.	LC	230	550/1100
15	Gen. Elec.	RC	115	1150
15	Roth	85RS	230	1750
15	G.E. b.b. NEW	CDM67	115	1750
15	Gen. Elec.	RC10	230	1150
15	Whse. (5)	SK90	230	825

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
150	Cr. Wheeler b.b.	TEFC	250	1200
105	Century b.b.	1500a	70	1200
100	Whse. 3 wire	SK	125/250	750
100	Gen. Elec.	RC17	125	1200
75	Cr. Wh. b.b.	53H	250	1150
75	Whse.	S	125	600
60	Whse.	SK	250	900
25	Whse.	SK	250	1750
25	G.E. NEW b.b.	CD93	125	1450
24	Whse.	SK	600	850
15	Gen. Elec.	RC	125	1200

EXPLOSION PROOF MOTORS—NEW

1—3 HP 1200 RPM
2—7½ HP 1800 RPM
1—7½ HP 900 RPM
3—5 HP 1800 RPM
1—10 HP 900 RPM
1—15 HP 1800 RPM
2—20 HP 1800 RPM

A. C. MOTORS—25 CYCLE

H.P.	Mfr.	Type	Volts	Speed
300	Whse.	Synch.	2300	750
150	Whse.	Synch.	440	750
150	Whse.	HF	440	500
75	Whse.	CS	440	500
50	G.E. int.	MTC5337	440	750
50	Allis Ch.	ANY	440	1500
40	G.E.	I-K	440	750
30	G.E.	KT	440	750
25	Howell	SR	440	750

A. C. GENERATORS—60 Cycle

KVA	Mfr.	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
500	Allis Ch.	3 brg.	240/480	360
300	Gen. Elec.	ATB	240/480	720
250	Whse.	G	2300	600
200	Gen. Elec.	ATB	240/480	900
187	El. Machy.	late	240/480	514
156	G.E. 1 brg.	ATB7558	240/480	1200
125	Whse.	G	240/480	720
125	Gen. Elec.	ATB	240/480	300
125	Whse. 25 cycle	G	240/480	750
100	Whse.	G	2300	900
63	El. Machy.	180 cy.	240/480	1800
60	El. Machy.		240/480	900
56	Gen. Elec.	ATB	240/480	900
50	Cont. b.b.	S107	120/208	1200
12½	Whse. b.b. NEW		240	1200

A. C. MOTORS—SLIP RING

3 phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	800	Allis Ch. 2200 V.	ANY	450
1—	600	Gen. Elec.	I-M	360
1—	300	G.E. 2200 V.	I-M	1800
1—	300	Gen. Elec.	I-M-E16	900
1—	200	Gen. Elec.	IM-E13B	1800
1—	200	Whse. 3 brg.	HF	600
1—	200	G.E. 2200 V.	IM-15A	720
1—	150	G.E. 2200 V.	I-M	1200
1—	150	G.E. int. duty	ITC-15	720
1—	125	Wagner	BR	900
1—	125	Cr. Wheeler	SR	600
1—	100	Allis Ch.	ANY	1800
1—	100	Al. Ch. b.b. NEW	ARY	600
1—	75	Gen. Elec.	MT558	600
2—	75	Gen. Elec.	IM-14	600
1—	75	Gen. Elec.	MT337	1800
1—	50	Fair Morse	BV	720
1—	50	Gen. Elec. int.	ITC	600
1—	50	Whse. int.	CI	600
2—	40	Gen. Elec.	MT336	900
1—	40	Allis Ch.	ANY	450
1—	37	G.e. int.	ITC	600
1—	35	Lancashire	b.b.	1800
1—	30	Gen. Elec.	OMT336	1200
1—	30	Gen. Elec.	MT346	600
1—	25	Triumph	SR	1200
1—	25	Gen. Elec.	I-M	600
1—	20	G.E. b.b.	MT503	1800
1—	20	P & H b.b. int.	W18	1200
1—	20	Gen. Elec.	MT332	720
2—	20	G.E. int.	MTC5302	1200
1—	15	Gen. Elec.	MT502	1200
1—	15	Watson	KHV	720
1—	15	P & H b.b. int.	W7	1200

A. C. MOTORS—SYNCHRONOUS

H.P.	Mfr.	Type	Volts	Speed
667	Gen. Elec.	ATI	2200	450
300	Whse.	G	2200/440	600
250	Ideal	2BC-M4	2200	450
200	Gen. Elec.	ATI	220/440	900
150	Gen. Elec.	ATI	2200	450
150	Gen. Elec.	ATI	220/440	300
150	Gen. Elec.	ATI	220/440	600
125	Whse.	G	2300	900
125	G.E. splprf.	TS955	220/440	1200
100	American b.b.	YGH	220/440	900
75	El. Machy	BRKT	550	900
60	Gen. Elec.	ATI	220/440	900

A. C. MOTORS—SQUIRREL CAGE

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	250	G.E. 2200 V.	I-K	600
1—	150	Whse.	CS	1200
1—	150	Reliance b.b. NEW	B6085	1200
1—	150	Lincoln	IU	720
1—	150	Reliance b.b. encl.	AA	900
1—	150	Fair. Morse	B	600
1—	150	Al. Ch. b.b.	2200 V.	720
1—	125	Reliance b.b. NEW	B6085S	1800
1—	125	Reliance b.b. NEW	B6085	1200
1—	125	Cont. 2200 V. b.b.	SC	1800
1—	100	G.E. b.b. NEW	K504S	1800
1—	100	Gen. Elec.	KT343	1800
1—	75	Reliance TEFC NEW	C5084	1200
1—	75	Gen. Elec.	KT337	1800
1—	75	Reliance b.b. NEW	C505	1800
1—	75	Gen. Elec.	KT329Y	3600
1—	75	Gen. Elec.	I-K	720
2—	60	Reliance b.b. NEW	C504	1200
1—	60	Allis Ch. 4000/2200 V.	AR623	1800
1—	60	Gen. Elec.	I-K	600
1—	60	Whse. b.b. NEW	CS444S	1800
1—	50	G.E. TEFC b.b.	KF445	3600
1—	50	Whse. b.b. NEW	CS405S	1800
1—	50	G.E. 2 phase	I-Q	900
2—	50	G.E. NEW b.b. HT	KG405	1800
2—	50	Reliance b.b. NEW	C445	1200
2—	50	Gen. Elec.	KT336	1200
1—	50	Gen. Elec.	KT342	900
1—	50	Whse. vertical	CS766	900
1—	40	G.E. NEW	K404	1800
1—	40	Howell b.b.	SC	1800
1—	40	Al. Ch. 3 speed	ARX	900/600/450
5—	40	Gen. Elec.	KT336	900
2—	40	G.E.	KT	1200
2—	35	Gen. Elec.	I-K	720
2—	30	Howell b.b. 4 speed	SC	1800
2—	30	G.W. NEW b.b.	K365	1800
2—	30	G.E. NEW hitorq	KG365	1800
2—	30	Whse. NFW b.b.	CS405	1200
2—	30	G.E. TEFC b.b.	K404	1800
1—	30	Gen. Elec.	I-K	900
1—	30	Gen. Elec.	KT336	720
1—	30	Wagner	22T8P	900
1—	30	Whse.	CS646	900
2—	30	Reliance TEFC NEW	C444	1200
5—	25	Reliance b.b. NEW	C364	1800
2—	25	Reliance TEFC NEW	B365	1800
2—	25	Reliance b.b. NEW	C404	1200
2—	25	Reliance TEFC NEW	C405	1200
2—	25	Whse. NEW spl. b.b.	CS365	1800
1—	25	Gen. Elec.	IK	1200
1—	25	Allis Ch.	AN	1200
3—	25	Whse.	CS646	900
2—	25	Gen. Elec.	I-K	600
1—	20	G.E. TEFC b.b.	K404	1200
1—	20	U.S. NEW b.b.	SC326	3600
1—	20	Gen. Elec.	KT182	3600
4—	20	Reliance b.b. NEW	C364	1800
2—	20	L.A. NEW exp. prf.	EX364	1800
2—	20	Whse. NEW b.b. spl.	CS364	1800
2—	20	Gen. Elec.	KT312	1200
2—	20	Gen. Elec.	I-K	1200
1—	20	Whse.	CS	1200
1—	20	Gen. Elec. b.b.	I-K	900
2—	20	G.E. NEW b.b.	K365	1200
2—	20	Diehl TEFC NEW	INF364	1800
2—	20	Century b.b. 4 speed	SC594	1800
2—	15	Whse. Splashprf.	C3365	1200
2—	15	Whse. TEFC NEW	CS365	1200
4—	15	G.E. NEW b.b.	K324	3600
2—	15	Diehl NEW b.b.	D1326	1800
2—	15	Whse. NEW TEFC	CS326	1800
1—	15	Diehl. TEFC NEW	INF365	1200
2—	15	Gen. Elec.	KT954	1800
4—	15	Gen. Elec.	KT302	1200
1—	15	Gen. Elec.	KT512	900
1—	15	L. Allis	OX365	900

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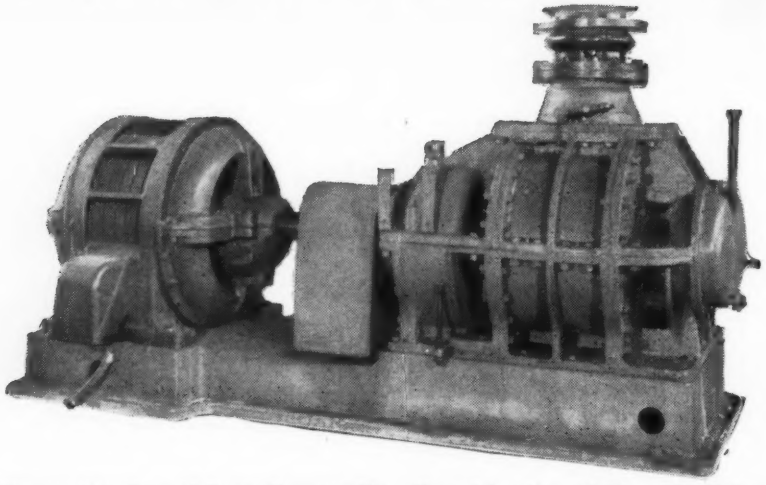

Blowers (Air Pumps) Roots-Connersville. Sizes 16 x 18 and 20 x 23. Driven by 3/60/2300 Motors.

BOILERS

10—Cleaver-Brooks, 2000# steam pr. hr. 35# press.
6—Cyclotherm 3000 pounds steam per hour, 125# press.
6—Express Boilers, modified D type, Foster Wheeler 30,000# steam/hr., 435# press., with economizers, superheaters, desuperheaters, oil burners, etc.
8—B&W, D type, 580# press., 5400 sq.ft. heating surface.

DISTILLING PLANTS

2—40,000 gallons per day, Foster Wheeler triple effect low pressure.
1—80 tons per day. Condenser Service, double effect.
10—2000 gals. per day Kleinschmidt vapor compression distiller mfd. by Badger.
1—750 gals. per day, same as above.

HYDRAULIC PUMPS

5—Vertical, quintuplex, 4⅝ x 10, 450 gpm at 128 RPM against 2500 p. s. i., mfd. by Aldrich driven by 700 HP synchr. motors 3/60/2300.

CONDENSERS—ALL NEW

3—14750 sq. ft. 2— 1050 sq. ft
1— 8533 sq. ft. 10— 400 sq. ft
10— 3800 sq. ft. 8— 155 sq. ft.
10— 206 sq. ft.—H.P. feed heaters

REDUCTION GEARS

4—1800 HP 2.41:1 10—20 HP 41:1
10— 900 HP 2.48:1 10—11 HP 39:1
10— 25 HP 20:1 10—10 HP 1750:63
7—Waterbury hydr. type K, size 35, 5 and 2A

HOISTS

10—100,000# pull at 10 FPM to 3000# pull at 400 FPM, 2 Gypsies 12000# pull at 125 FPM, driven by 50 HP 230v. D.C. motors 525—1800 RPM.

15—15,000# pull at 78 FPM, 3360# pull at 348 FPM and 2 auxiliary drums. Driven by Chrysler 28.35 H.P. gasoline engines. (NEW).

MOTORS

3 Ph. 60 Cy.
6—3800 HP 1700 V 257 RPM G.E.
5— 700 HP 2300 V 128 RPM

D. C.
1500 HP 525 V DC 600 RPM W'hse

GENERATORS

1200 KW 525 V DC 750 RPM All. Chalm.
1075 KW 375 V DC 750 RPM Elliott
700 KW 240 V DC 500/720 Elliott
540 KW 240 V DC 1200 RPM West.
100 KW 120/240 1200 RPM Delco

TURBO-GENERATORS—A.C.

6—300 KW G.E. type ATI 3/60/450, 1200 RPM cond., compl., with 40 KW exciters, condensers, switchboards.
2—250 KW G.E. type ATI 3/60/450, 1200 RPM, cond.
2—200 KW Westinghouse, 3/60/450, 1200 RPM cond. (NEW).
8—200 KW, G.E. type ATB 3/60/450, 1200 RPM cond. and non-cond.
2—132 KW G.E. type ATB 3/60/450, 1200 RPM, cond.

TURBO-GENERATORS—D.C.

KW	Volts	Winding	Speed	Type
2—375	180/240	Shunt	1200	non-cond.
12—150	120	Shunt	1200	cond.
20— 60	120	Stab. Sh.	1800	cond.
3— 25	120	Stab. Sh.	1200	cond.

AXIAL FLOW FANS

10,000 CFM, 3" S.P. 3/60/450 motors
5,000 CFM, 3" S.P. 3/60/450 motors
Rugged construction, acid resisting vanes, totally enclosed motors, all NEW

WIRE ROPE SLINGS

⅜" to 2½" various lengths
Also: Steel blocks, treble, 18" Sheave, capacity 15 ts and 30 ts.

DIESEL ENGINES

	Make	Model	H.P.	R.P.M.	Cycle	Cylinders	Bore & Stroke	Year	Reverse Reduction Gear
4	General Motors	16-258S	1800	900	4	16	9½" × 12"	1943	2.41:1 (fluid coupling)
2	Hamilton	R.B. 99-D.A.	1600	700	2	9	9⅛" × 13⅜"	1944	
8	Fairbanks Morse	38D O/P	1600	720	2	10	8⅛" × 10"	1944	Reversible, Hydr clutch
8	General Motors	16-278A	1600	720	2	16	8¾" × 10½"	1944	
4	General Motors	12-278A	1200	750	2	12	8¾ × 10½"	1944	Falk 2.5:1
35	General Motors	12-567ATL	900	744	2	12	8½" × 10"	1942-44	Falk 2.5:1
2	General Motors	8-268A	500	1200	2	8	6½" × 7"	1943	2.54:1
3	Fairbanks Morse	38 O/P	300	1200	2	6	8" × 6"	1936	
20	General Motors	6-71	225	2100	2	6	4¼" × 5"	1944	
4	Buda	6LD468	95	1850	4	6	4¼" × 5½"	Driving fire pumps 1000 gpm, 280 ft. head.	

Ask For Our Complete 1948 CATALOG

DIESEL GENERATOR SETS—A.C.

	Make	Model	H.P.	R.P.M.	Cycle	Cylinders	Bore & Stroke	Year	KW	Volts	Cycles	Exciter Phase	Exciter KW	Exciter Volt
3	General Motors	8-268A	350	1200	2	8	6½" × 7"	1943	200	440	60	3	40	120/240
2	General Motors	3-268A	150	1200	2	3	6½" × 7"	1943	100	440	60	3	20	120/240

DIESEL GENERATOR SETS—D.C.

7	General Motors	16-278A	1600	750	2	16	8¾" × 10½"	1943	1200	525	Allis Chalmers Type MHC 2290 AMPS
4	General Motors	12-278A	1200	750	2	12	8¾" × 10½"	1943	1200	240	Elliott
2	General Motors	2-268A	500	1200	2	8	6½" × 7"	1944	375	120/180/240	Westinghouse
50	Superior	GDB-8	150	1200	4	8	5½" × 7"	1942-44	100	120/240	Delco 3 wire stab. shunt 60° C rise
4	General Motors	3-268A	150	1200	2	3	6½" × 7"	1943-44	100	120/240	Allis Chalmers 3 wire stab. shunt

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POWER EQUIPMENT—READY TO SHIP

SAVE OVER 50% ON NEW INDUSTRIAL BLOWERS AND VENTILATING FANS

AXIAL FLOW VENTILATING FANS

5—50" dia. 72½" long, 2 sets of propellers, 8 blades to each. Dim: of blade, 14"x 9½" curved mfg'd by International. Size 114, driven by 100 HP., 1750 rpm., 220/440 v. 3 ph. 60 cy. A.C. Motor.
6—16000 CFM Buffalo Forge Co., 3" stat. pres. 1800/1200 rpm. con. 15/4.5 HP., 1710/1150 rpm., 3 ph. 60 cy. G.E. A.C. Motor 220/440 v. totally encl.
2—12000 CFM 3" stat. pres. Sturtevant with dir. con. 10/3 HP., 1775/1180 rpm., 220/440 v. West. CS. TEFC Motor.
1—7500 cfm Clarage with dir. con. 7½ hp., 1750 rpm., 3.3 HP. at 1160 rpm., 220/440 v. 3 ph. 60 cy.
2—6000 cfm Sturtevant 1.65" stat. pres. dir. con. 2.7/.8 HP. 220/3/60 A.C. Motor.
31—6000 cfm Sturtevant Bulletin 512389, 3" stat. pres. 7 blade, dir. con. 5/1.5 HP., 1765/1175 rpm., 220/440 v. 3 ph. 60 cy. West. TEFC Motors.
2—5000 cfm Sturtevant 1.8 stat. pres. 4.2/1.25 HP., 1750/1150 rpm., 3 ph. 60 cy., 220/440 v. ball bearing motors.
2—4000 cfm 3" stat. pres. Sturtevant dir. con. 2 speed, TE Westinghouse 220/440 v. Motors.
1—4000 cfm 3" stat. pres. Sturtevant Axial Flow vent fan dir. con. 4/1.2 HP., 1750/1150 rpm., 220/440 v., 3 ph. 60 cy. Tot. Enc. West. Motor.

115 Volt, D. C.

8—4000 CFM Sturtevant 3" stat. pres. 115 v. Westinghouse SK Motors.
4—4000 cfm American Blower 3" stat. pres. 4/1.7 HP., 1750/1310 rpm., 115 v. Westinghouse SK Motors.
1—3000 cfm 3" stat. pres. B. F. Sturtevant 1750 rpm., dir. con. 3/1.25 HP., 115 v. D.C. Motor.
1—250 CFM—2½" stat. L. J. Wing, with dir. con. 1/5 HP., 3300 rpm. Diehl Motor.

NEW—CENTRIFUGAL BLOWERS

1—7500 CFM "Sirocco" 2.2 stat. pres. 1160 rpm., size 275-85 mfg. by American Blower dir. con. 7½ hp., 1160 rpm., 220/440 v. 3 ph. 60 cy. Wagner TEFC Motor.
1—6100 CFM "SIROCCO" 2.2 stat. pres. mfg'd by American Blower dir. con. 220/440 v. 3 ph. 60 cy. A.C. Motor.
1—5700 CFM Sirocco 2.2 stat. pres. size 2½. mfg. by American Blower dir. con. 2 speed 220 or 440 v. TEFC ball bearing Motor.
1—Roots Connersville Industrial Blower 16 x30 with 8 to 1 ratio gear reduction unit, dual shaft unit with single pulley shaft complete with 75 P. 220 or 440 v. 3 ph. 60 cy. A.C. Motor.

A. C. MOTORS

3 ph. 60 cy.

No.	HP	Type	Make	RPM	Volts
1 New	500	Syn	Elec. Machy.	120	2200/4000/440/220
1	200	CS	West.	900	220/440
1	150	Syn	West.	257	220/440
1	150	CS	West.	720	220/440
1	150	CS	West.	1700	2200
4	150	FX	Louis Al.	1800	220/440
1	125	Syn	Elec. Machy.	164	220/440
2	125		Reliance	600	220/440
2	125		West.	720	2200/220/440
2	100		Reliance	495	220/440
2	100		West.	500	2200/220/440
2	100		G.E.	600	220/440
2	100	Syn	Elec. Machy.	720	220/440
5	100	TEFC	Master	1750	220/440
2	75		G.E.	490	220/440
1	75	Syn	Elec. Mach.	900	220/440
1 New	75	CS	West.	3600	220/440
3	50	K	G.E.	1800	220/440

BRAND NEW SAFETY SWITCHES

3 P. S. T.

800—60 amp., 550/440 or 220 v. A.C. Wadsworth non-fusible Safety Switches, Catalog No. 8963.
Price **$10.50** each.
77—60 amp., 230 v. A.C. Wadsworth—fusible Safety Switches, Catalog No. 8763A.
Price **$13.50** each.
• Special Discounts on quantities.

MOTOR GENERATOR SETS

250 V. D. C.

Motors 220/440 or 2200 v. 3 ph. 60 cy.

No.	KW	Make	Speed
1	150	West.	1800
1	135	G.E.	1200
1	100	West.	1800
2	100	Delco	1150
2	75	West.	720
1	50	Cr. Wh.	900
2	50	West.	490
1	40	G.E.	720
3	40	West.	900
1	40	G.E.	1750
1	35	G.E.	850 (850)
1	30	G.E.	680
1	30	West.	850
1	25	West.	1150
1	20	G.E.	1150
2	20	Delco	1100
2	15	West.	1900
1	7½	West.	1150
1	5	West.	1150

VARIABLE SPEED MOTORS

230 V. D. C.

No.	HP	Make	Type	RPM
3	133	G.E.	CDM	875/1750
4	50	West.	SK-190	320/960
4	50	West.	SK	300/1200
1	45	West.	SK-143	500/1500
1	40	West.	SK-180	385/1200
1	40	Al. Chal.		400/1200
1	35	West.	SK-143	500/1500
1	30	G.E.	DLC-50	400/1200
1	20	West.	SK-123	400/1600
1	20	West.	SK-110	500/1500
1	15	West.	SK-100	500/1500
2	10	G.E.	RF	400/1200

TRANSFORMERS

1 ph. 60 cy.

No.	KVA	Make	Pri.	Sec.
25 new	25	Allis Chal.	450	120
20 new	25	Allis Chal.	440	110/220
15 new	25	Allis Chal.	220	220/110
3 new	37½	West.	450	120
1	50	G.E.	2300	220/440
3	50	West.	11000	2200

SLIP RING MOTORS

3 ph. 60 cy.

No.	HP	Type	Volts	Make	RPM
2	700	MT-415	2200	G.E.	900
2	600	MT	2200	G.E.	900
2	400	MT	2200	G.E.	900
1	75	I-M	220/440	G.E.	600
6	50	CW	2200/220/440	West.	860

NEW FLEXIBLE COUPLINGS

120— New Lovejoy bronze flexible couplings ... bore with Neoprene spider. Cat. No. 1A-100, can be bored to 1⅛", 1¼" and 1⅜". Can be bushed down to ½". Price **$4.85** each.
• Special Discounts on quantities.

CIRCUIT BREAKER

1—3000 Amp. ITE, type LG, 6 pole, rigid arm, solenoid operated, for 440 v. 3 ph. 60 cy.

SURFACE COMBUSTION GARDEN CITY HEAT TYPE EXHAUSTERS

3—#55 Single SSP, 14000 cfm at 1292 rpm., S.P. @ 70 deg. F and 8" water for 1200 deg. F. operation.
2—#50 Single SSP, 10000 cfm at 1375 rpm., S.P. @ 70 deg. F and 8" water for 1200 deg. F. operation.

DYNAMOMETER

"Hi-Eff" hydraulic size 35#, model 58S, 3100 rpm., Taylor Mfg. Co.

FREQUENCY CHANGERS

1—25 kw., 220/440 v. 3 ph. 180 cy., G.E. dir. con. to 25 HP., 1800 rpm., 220/440 v. 3 ph. 60 cy. Motors.

SPECIAL BARGAIN AIR COMPRESSORS

7—240 CFM Westinghouse type 3 VS-23 3 cyl. vert., 150 lbs. pres. dir. con. to 50 HP., 220/440 or 2200 v. 3 ph. 60 cy. West Slip Ring Motors, auto. control. Can furnish D.C. Motors or Oil or Gasoline Engines if desired.

SYNCHRONOUS MOTORS

1—New 500 HP., Elec. Machy. Co. 2200/220 or 440 v. 120 rpm.

ENGINE GENERATOR SETS

10—NEW 1 kw. 14.25 v. D.C. and 2 kw., 28.5 v. D.C. Homelite portable gas eng. Gen. sets. Can furnish lamps and batteries. Suitable for farms and camps.
3—5 kva. 120/240 v. 1 ph. 60 cy. Witte Diesel.
1—10 kw., 115 v. D.C. 1200 rpm., Hercules DIESEL.
30—NEW 25 kva. West. 120/208 v. 1 and 3 ph. 60 cy. LeRoi GAS.
1—35 kva. 220/440 v. 3 ph. 60 cy. 257 rpm., Ridgway STEAM.
3—100 kw., 240/120 v. Delco 1200 rpm., dir. driven by 150 HP. Superior GBD-8 5½" x7" 8 cyl. DIESEL.
1—125 kva. G.E. 220/440 v. 3 ph. 60 cy., dir. con. Skinner UNIFLOW Engine.

INDUCTION HEATING CONVERTER

New Van Norman, type indoor, floor, hi-freq. 32 kw. 220 v. 1 ph., 60 cy. 150 A. enclosed type.

PUMPS

3—1000 GPM Worthington Cent. 1 stage, 6½" suc. 5" dis. 150# pres. dir. con. 133 HP., 875/1750 rpm., 230 v. D.C. Motors and control. (Can furnish A.C. Motors if desired.)

WINCHES

240—Winch assembly portable engine hoists, swivel hook, 4¾" l, with 1½" opening and 30' of ¼" cable. Hand cranked, double reduction gear with drum 5¾" w. can be used with A.C. or D.C. Motors.

CONDENSER

450 kva., Elec. Machy. 2200/220 or 440 v. 3 ph. 60 cy., 120 rpm.

CAR PULLER or WINCH

1—Welen, 2 drum Winch or Car Puller rated 8600# per drum with 25 HP. G.E. Vertical Motor 230 v. D.C.

SPEED REDUCER

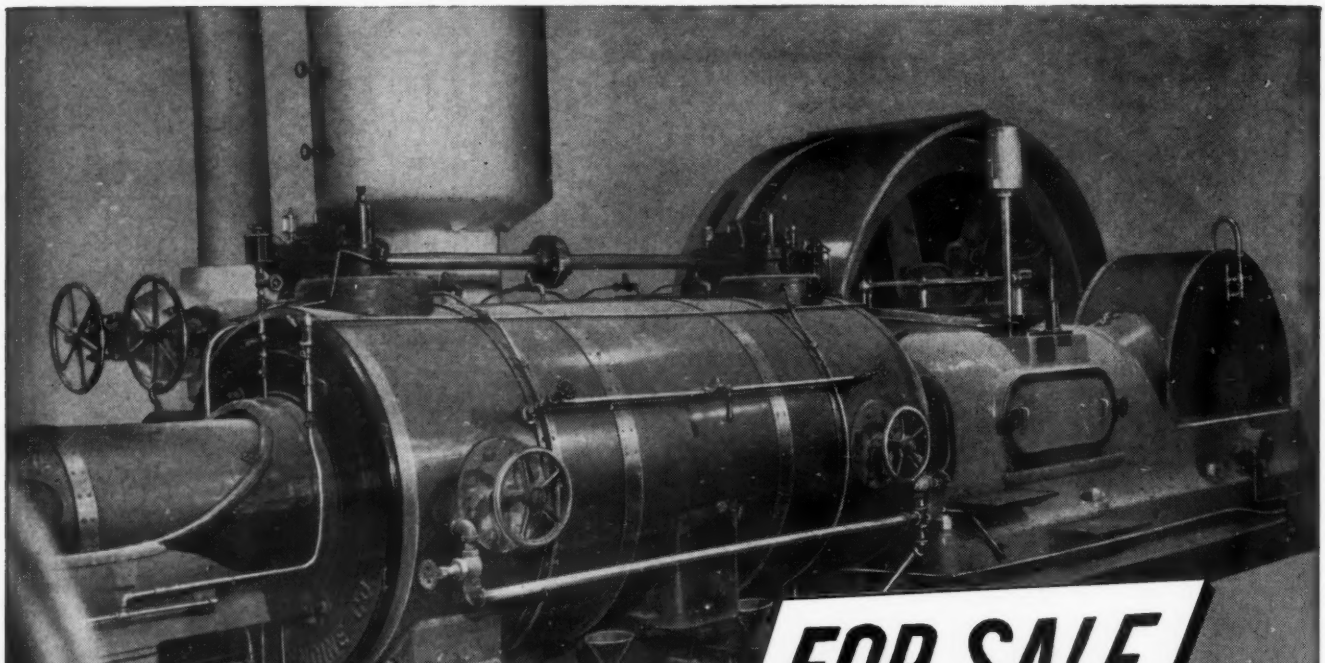
800 HP. United Engineering Co., double reduction gear Drive ratio 16.4 tol, used with 800 HP., 360 rpm. motor.

GEAR HEAD MOTOR

50 HP., G.E. 220/440 or 550 v., 3 ph. 60 cy., 1755 to 13 rpm., splash proof, ball bearing.

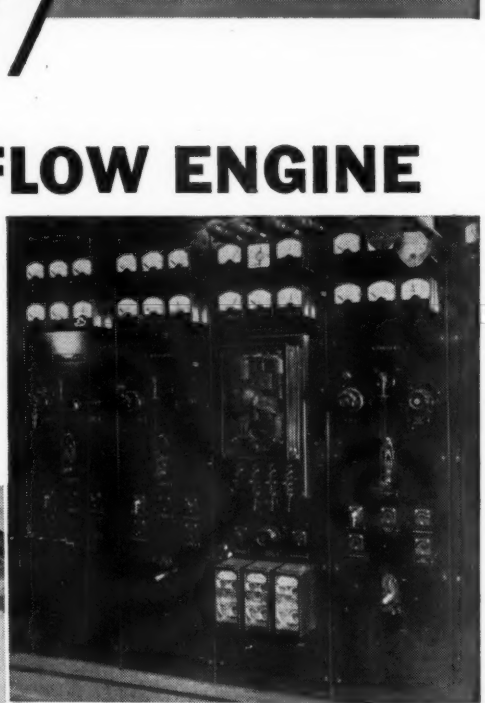
WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.



2 Complete, Modern

575 KVA SKINNER UNAFLOW ENGINE GENERATOR UNITS



2— 750 HP Skinner unaflow engines, each directly connected to 575 KVA Westinghouse 220 volt, 3 phase, 60 cycle, 150 RPM alternating current generator, with

15 KW "V" belt-driven exciters

Complete switchboard control apparatus, with switchboard operated variable speed synchronizing devices and automatic voltage regulators.

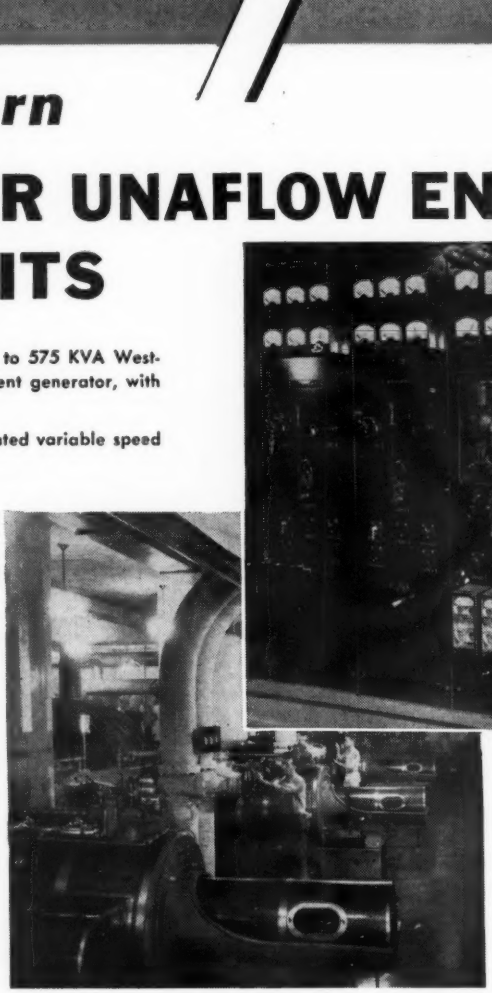
Also Available:

2— surface condensers with motor-driven circulating pumps.

2— 250 HP low pressure condensing steam turbines with auxiliaries.

This plant is one of the most modern medium-size steam power plants on the West Coast. It is complete in every detail.

The units were installed in 1935 and furnished complete power service for the building and presses of the Los Angeles Times. The plant has always been well maintained and is being removed from the Times Building now only because it is too small to furnish power for the building which is being enlarged to double capacity.



This complete steam power plant is offered for immediate shipment, F.O.B. Los Angeles. For further information write or telephone.

Beeson Brothers Engineering Co.
1628 E. 7th Street • Los Angeles 21, California
Telephone **MUtual 9151**

Motors

. . always a wide selection . . . always unusual values

Listed below a few of the motors available in a hurry from Wente

SQUIRREL CAGE
3 Phase, 60 Cycle, 220 or 440 Volt
(Other voltage as noted)

Qu	HP	Make	Type	Speed
1	250	G.E.	KF Vert.	3600
1	200	G E.	K-566, 2300 Volt	720
1	250	F.M.	HF 2200 Volt	720
1	150	Al. Ch.		1750
2	125	Ch. Wh.	126Q	430
6	125	Al. Ch.	AR. ball bearing	450
1	120	G.E.	FT	3600
1	60	Reliance	AA	900
1	50	R. & M.	L	1200
1	50	Al. Ch.	AN	900
1	50	G.E.	I 2200 Volt	900
1	50	G.E.	I	720
2	40	F.-M.	B. ball bearing	900
1	40	F.-M.		600
2	35	Al. Ch.	2 phase	900
1	35	Al. Ch.	B	900
1	30/30	West.	CS TEFCBB	1800/900
1	30	F.-M.	QZK Open BB	1200
1	30	Cr. Wh.		900
2	30	Al. Ch.	AS 2 Phase	900
1	30	Century	AS	720
1	35	Howell		1200
1	25	F.-M.	QZK B.B. New	1200
1	25	Wagner	BP	1200
1	25	Burke	EM3	900
1	25	Lincoln		900
1	25	Al. Ch.	AN	720
1	25	G.E.	M10	720
2	20	U.S.	SC SP B.B.	1800
1	20	F.-M.	QZK B.V. New	1800
1	20	West.	CS	1800
1	30	Howell	N. Vert. B.B. New	1200
1	20	F.-M.	KRV	1200
1	20	Cr. Wh.		900
1	20	G.E.	I-K 2200 Volt	900
1	20	Cleve.	M	900
1	20	Al. Ch.		900
1	18	West.	MS (Elev.)	720
1	15	F.-M.	HLS	3600
4	15	F.-M.	QZK B.B. New	1800
1	10	Al Ch.		
1	10	Imperial	EH B.B.	1200
5	7½	G.E.	KT	1800
1	7½	West.	CS	1800
3	7½	Wagner	11VRW	1800
3	7½	G.E.	KT	1200
15	3	Imperial	E (New)	1200

Approx. 200 New motors from 2 HP—30 HP.

SLIP RING & SYNCHRONOUS
3 Phase, 60 Cycle, 220 or 440 Volt
(Other voltage as noted)

Qu	HP	Make	Type	Speed
1	125	F. M.	T 4800/2800 Volt syn.	900
1	100KW	G.E.	ATB Syn.	900
1	100	G.E.	I-16 2200 Volt	450
1	100KVA	G.E.	TRB Syn.	600
1	75	West.	CW	400
1	75	G.E.	I	514
1	75	F. M.	BV 2200 Volt	1800
1	75	West.	(New) Syn.	1200
1	60	Ideal	AVX	1200
1	50	Al. Ch.		514
1	50	G.E.	I 25 Cycle	700
1	50	Al. Ch.		720
1	50	Ideal	AV 2200 Volt	600
1	40	West.	CW	1160
1	40	G.E.	MT	1200
1	40	Al. Ch.		1200
1	40	G.E.	MT	900
2	40	West.	CW 2200 Volt	900
2	40	West.	CW	900
2	40	Al. Ch.		900
1	40	West.	CI	730
1	40	Burke	EMV7	1150/550
1	35	Al. Ch.		720
1	35	G.E.	I-12	600
1	30	Al. Ch.	2200 Volt	720
1	25	Cr. Wh.		1200
1	25	West.	CW	720
1	25	West.	MW	720
1	25	G.E.	MT Tot. Encl.	600
1	25	G.E.	MT	400

DC—230 Volt
(Other voltage as noted)

Qu	HP	Make	Type	Speed
1	150	West.	SK184	850
1	130	Cr. Wh.	CMC 550 Volt	1200
1	125	West.	SK	600

DC—230 Volt

1	100	G.E.	CD	1200
1	100	West.	SK	1800
4	100	Cr. Wh.	CMC	225/550
1	75	Diehl	K11	700
1	60	West.	SK 115 Volt (Vert.)	1200
2	50	G.E.	CD 1341Y	500/2000
3	50	Rel.	T	2700/2900
3	50	West.	SK	1200
1	40	Rel.	440 Volt B.B. Vert.	1800
1	40	Rel.	440 Volt B.B. (Vert.)	1200/1800
1	25/40	Cr. Wh.	CMC 440 Volt (Vert.)	1200/1800
1	40	Rel.	B. P.	400/1500
2	40	West.	SK	1200
1	40	G.E.	RC	1200
7	40	West.		775
1	35	G.E.	OMTEBB	1300
1	35	West.	SK	1200
1	35	Al. Ch.		1200
1	35	G.E.	DLC	700
2	30	El. Dy.	15S	625/1250
5	30	Rel.	92TF	1800
1	30	Rel.	131 440 Volt (Vert.)	1200
1	30	G.E.	RC	1200
1	30KW	Al. Ch.	110 Volt	925
1	27½	G.E.	CVC116	1800
1	25	Cr. Wh.	CM 110 Volt	900/1200
1	25	Al. Ch.	E120	500/150
1	25	Rel.	25P	250/1000
1	25	G.E.	RF	300/900
1	25	F.M.	IRC	400/800
6	25	West.	SK	1200
7	25	West.	SK	850
2	20	Rel.	131T	1000/2000
2	20	West.	SK	750/1500
1	20	Diehl	K9	500/1000
1	20	G.E.	CD	400/1600
1	20	G.E.	RF	250/1000
1	20	Lincoln	FKW B.B.	1800
6	20	Cr. Wh.	CMC Enclosed	1800
1	20	Cr. Wh.	CMCTEBB (Exp.)	1200
1	20	Rel.	92T	1200

DC—230 Volt

2	20	West.	SK	1200
1	20	West.	SK	900
1	20	G.E.	RC	900
7	20	West.	SK	750
1	20	West.	SK	500
1	15	West.	SK63	1800
1	15	West.	SK113 Encl.	1800
1	15	F.M.	D B. B.	1150
6	15	Rel.	66T	1150
2	15	Cr. Wh.	CCM	1150
1	15	Cr. Wh.	CCM Tot. Encl.	1500
1	15	West.	SK83	1150
2	15	West.	SK80L	1150
1	15	G.E.	CD	1150
1	15	West.	SK90	850
1	15	West.	KS Crane	630
8	15	Rel.	92F	850/1700
1	15	Rel.	131T 115v	600/1500
2	15	West.	SK	600/1200
1	15	Rel.	78T	400/1600
1	15	G.E.	RE11	400/1200
1	12½	West.	SK	750/1500
1	12	G.E.	RF	575/1725
1	10	West.	SK7	850/1700
2	10	G.E.	RF10	600/1800
1	10	West.	SK90	600/1800
7	10	West.	SK80L	500/1500
20	10	Al. Ch.		500/1000
1	10	Rel.	92 TF	400/1000
1	10	West.	SK	250/1000
6	10	Cr. Wh.	CMTEBB	1800
1	10	Century	R304	1800
15	10	West.	SK	1150
2	10	West.	SK 115 Volt	1150
3	10	Rel.	46TF	1150
1	10	G.E.	RC9	1150
2	10	Rel.	66TF	850
2	10	G.E.	RC	850
3	10	West.	SK70	850
1	10	G.E.	RC29 550 Volt	850
1	10	Colonial		950
14	7½	West.	SK33	1750
4	7½	West.	SK601	850
20	5	West. & Gen. Elec.		1750
20	5	West. & Reliance		1150
35	5	West.	SK43	850

Hundreds of other DC motors not listed

27—New vertical, T.E.F.C.B.B., 3 Ph., 60 Cy. 220/440 volt as follows:
1—Fairbanks-Morse, 3 HP. ty. QZCU. Fr. 254, 1200 RPM Exp.
2—General Electric, 3 HP. ty. K Fr. 254, 1200 RPM
8—General Electric, 7½ HP. ty. Fr. 324, 1200 RPM
8—Delco, 7½, type C, Fr. 324, 1200 RPM
1—Howell, 7 HP. type KV., Fr. 284 1800 RPM
5—General Electric, 15 HP. type K, Fr. 365, 1200 RPM
2—Howell, 15 HP. type KV. Fr. 365, 1200 RPM

6—New Reliance, 30 KW, variable voltage M-G sets, 250 volt DC, 220/440 volt AC, 3 phase, 60 cycle, 1800 RPM, complete with exciters, all control and drive motors. All motors ball bearing. Inclosed: M-G set, exciters and control mounted in fan cooled inclosure.

1—1000 KW, General Electric, synchronous M-G set, 4600 volt AC, 275 volt DC, condition excellent—immediate delivery—complete data on application.

1—150 KW General Electric M-G set 250/275 volt DC, 440 volt AC, 3 phase, 60 cycle, 900 RPM

1—100 KW Ridgeway synchronous M-G set, 250 volt DC, 2300 volt AC, 3 phase, 60 cycle, 1200 RPM with AC control & DC panel

2—75 KW Star syn. M-G sets 240 volt DC—440 volt AC, 3 phase, 60 cycle, 1200 RPM

6—Practically new 40 KW Reliance & General Electric variable voltage M-G sets, 250 volt DC, 220/440 volt AC, 3 phase, 60 cycle, 1800 RPM, complete with exciters all control and drive motors. All motors ball bearing, enclosed M-G set, exciters and control mounted in fan cooled enclosures. Drive motor G.E., type CD, frame 1441, 40 HP, 230 volt 400/1600 RPM, enclosed, ball bearing, 50° Cont 250 RPM, 1 hr. 50°

The Wente Electric Co.

Hamilton — *Rebuilt Motors and Generators Since 1906* — **Ohio**

PHONE HAMILTON 4-8128

POWER SPECIALS A PARTIAL LISTING FROM CHICAGO'S LARGEST STOCK.

2 COMPLETE VARIABLE SPEED DRIVES

M.G. Set
200 KW DC generator, General Electric, type MPC, 250 volt, 800 amp, 1200 RPM, direct connected to 300 HP synchronous motor, General Electric, type TS, 3 ph, 60 cy, 440 volt, .8 P.F. 1200 RPM. D.C. Motor

250 HP, General Electric, type MPC, form A, 245 volt, 730/975 RPM.

With complete starting and control panels.

TRANSFORMERS

KVA	Type	Make	Pri.	Sec.
1-2500	Oil	Wstg.	2400	480
1-1500	Oil	Uptg.	34650	480
3-100	Dry	Wstg.	240/480	120/240
3-100	Oil	Wag.	4600/2300	460/230/115
6-75	Oil	G.E.	34500	6900/2300

A.C. GENERATORS

KVA	Make	Volts	Speed
1625	Wstghse.	2000	240
1125	Gen. Elec.	2200	257
1000	Wstghse.	2200	900
750	C. Whlr.	480	900
750	Gen. Elec.	2300	720
560	Al. Chlrs.	240	360
300	Al. Chlrs.	2300/4160	600
300	Gen. Elec.	480	450
200	Al. Chlrs.	2300	720
187	Gen. Elec.	480	900
100	Gen. Elec.	2200	900
75	Al. Chlrs.	440	1200
60	F. Mrse.	2300	300
60	F. Mrse.	460	900
50	C. Whlr.	240	1200
30	Gen. Elec.	240	1200
12½	M. Card	127/220	1200

SYNCHRONOUS MOTOR SPECIALS

2—200 HP Allis Chalmers, 3 ph. 60 cy, 2300 volt, 100% P.F. 360 RPM, pedestal sleeve bearing, were used on compressors.

SYNCHRONOUS MOTORS

HP	Make	Type	Volts	Speed
1000	Wstg.		2300	900
885	G.E.	ATI	11400	514
800	E.M.		6600	450
700	Wstg.		440	900
500	E.M.		2300	514
450	E.M.	2 brg.	440	240
400	G.E.	TS	440	600
300	Al. Ch.		2300	600
300	E.M.	2 brg.	2300	900
300	E.M.	2 brg.	440	900
250	Al. Ch.		2200	720
200	Al. Ch.		2200/440	360
100	G.E.	ATI	2300	900
75	Al. Ch.		240	1200
60	G.E.	ATI	220	900
60	Wstg.		220	1200

SQUIRREL CAGE MOTORS

HP	Make	Type	Volts	Speed
700	G.E.	KTP	440	1800
700	Wstg.	CS	4400/2200	1800
300	Al. Ch.		4500	720
200	G.E.	IK	2200	720
200	G.E.	KT	2200	600
200	Wstg.	CS	440	1800
125	G.E.	K	440	1200
100	Al. Ch.	AR	440	514
100	U.S. E.	CFU	220/440	1200
100	G.E.	K	220	1200
75	G.E.	I	2200	720
75	Wstg.	CS	2200	900
75	G.E.	K	220	1200
75	G.E.	K	220/440	1800
60	G.E.	K	220/440	1200
60	Al. Ch.	AR	220/440	600
60	G.E.	K	220/440	1800
50	Wstg.	CS	220/440	900
50	G.E.	K	220/440	1800
40	G.E.	KT	440	900
40	G.E.	K	220/440	1200
40	Wstg.	CS	220/440	1800
35	G.E.	I	440	720
30	Wstg.	CCL	220	900
30	G.E.	KF	220/440	1200
30	Wstg.	CS	440	1800
25	G.E.	K	220/440	1200

ROTARY CONVERTERS

3—375 KW General Electric, type HCC, 6 ph, 60 cy, comp. int. 275 volt, full automatic G.E. control, with transformers arranged for 2300, 4100, 6000, or 13200 volts.

SLIPRING MOTORS

HP	Make	Type	Volts	Speed
800	Wstg.	CW	6600/440	507
600	G.E.	IP	6600/2300	300
400	Al. Ch.	ANY	2300	514
300	G.E.	IM	2300	450
250	Al. Ch.		4000	900
250	Al. Ch.	ARY	220	705
60	Wstg.	CW	2300	870
50	G.E.	I	440	1720
50	L. Al.	GH	220/440	870
35	F. Mrse.	UAV	220	1800
35	Wstg.	CW	440	1200
35	G.E.	I	440	1140
30	Lincoln	FR	220	900
30	G.E.	I	440	1150
30	G.E.	MT	2200	1740
30	G.E.	ITC	440	1800
25	G.E.	IM	220	1140
25	G.E.	MT	220	1200
15	G.E.	MT	220	1125
15	Wstg.	I	440	830
10	Al. Ch.	ARY	440	860
7½	G.E.	MT	440	1200
5	G.E.	I	220	820
5	G.E.	MR	220/440	1665
5	G.E.	MTC	220	1200
3	G.E.	MR	220/440	1140
2½	G.E.	MTC	220	1200
1½	Wstg.	CW	440	1120
1½	G.E.	MT	220	1080
1	G.E.	MT	220	870
1	G.E.	MP	220	846
½	Cont'l.	SN	208	1720
½	G.E.	A	220	1800

Write for our latest stock catalogue—No. 4805-1

CHICAGO ELECTRIC COMPANY

1320 W. CERMAK RD. *CANAL 2900* **CHICAGO 8, ILL.**

ELECTRICAL AND POWER EQUIPMENT

M-G SETS—ROTARIES (3 ph. 60 cy.)

500 KW West. Factory built 250 v. cpd. int. 900 RPM, 714 HP .8 P. F. Westgh 2300 v. 3 ph. 60 cy. with control.

500 KW 250 v. G.E.—700 HP Ind. G.E.
300 KW 250/125 v. 1200 RPM—450 HP West. 2300 v. Motor.
300 KW 250 v. G.E. 600 RPM Rotary Bare.
300 KW 250/125 v. Dir. con. 450 HP Motor.
150 KW West. 125 v.—250 HP Ind. 2200 v.
100 KW 250 v. G.E.—150 HP Ind. West.
90 KW 60 v. West.—135 HP Ind. West.
75 KW 75 v. West.—100 HP West. Ind.
50 KW 125 v. G.E.—75 HP G.E. 2200 v.
40 KW 250 v. West.—60 HP. West. Ind.
15 KW 125 v. Wotten—25 HP 220/440 v.
10 KW 125 v.—15 HP Master 220/440 New.
7½ KW 250 v. West.—15 HP West. Ind.

AC & DC GENERATORS

9 KW 125 v. West. SK 80 L 900 RPM.
25 KW 125 v. SK 120 L West. 1150 RPM.
45 KW 250 v. S West. 1000 RPM.
60 KW 60 v. 1000 amp. West SK Welding.
2—150 KW. West. SK 125 v. 1200 RPM.
300 KW. West. 125/250 v. 1200 RPM.
1250 KVA West. 450/3/60 1200 RPM. New.

AC MOTORS (3 ph. 60 cy.)

HP	Make	Wdg.	Spd.	Type
1400	West.	Syn.	1200	1 P.F.
1000	West.	Syn.	1200	.8 P.F.
750	West.	Syn.	1200	.7 P.F.
600	G.E.	S.R.	900	MT
450	G.E.	S.R.	257	IM
300	West.	S.R.	600	CW
300	G.E.	S.R.	450	IM
300	West.	S.R.	1750	CW
250	Al. Ch.	S.R.	600	
200	West.	S.R.	880	CW
200	G.E.	S.C.	380	IK
150	G.E.	Syn.	720	TS
150	G.E.	Syn.	600	TS
150	G.E.	S.C.	450	IK
125	West.	Syn.	277	
100	G.E.	S.R.	450	IM

AC MOTORS (3 ph. 60 cy.)

HP	Make	Wdg.	Spd.	Type
80	G.E.	S.R.	900	MTC
75	West.	S.C.	690	CS
75	G.E.	S.R.	600	IM
75	Al. Ch.	S.C.	865	
50	West.	S.C.	865	CS
50	West.	S.R.	600	CW658 D
50	G.E.	S.R.	900	IM
50/12½	G.E. 2200v.	S.R.	900/450	IM
35	West.	S.C.	1120	CS
25	Cr. Wh.	S.C.	865	
25	West.	S.C.	600	CS
25	West. 550v.	S.C.	1750	CS 365
25	Cr. Wh.	S.R.	580	1210
15	L.A. TEFC	S.C.	3600	JX324
15	G.E.	S.R.	1710	MT 501
25	G.E. Vert.	S.R.	1200	MT330Y

(3 ph. 25 cy.)

HP	Make	Wdg.	Spd.	Type
300*	G.E.	S.R.	375	MT 415
100	G.E.	S.R.	500	MI-108

*Can be furnished with control.

AIR COMPRESSORS

1150 cu ft. 100# Chg. Pn. 19" x 11" & 12" 2 stage dir. con. 215 HP West. Syn. Motor 2300 v. 3 ph 60 cy. complete with exciter, starting panel, unloader, intercooler, aftercooler, receiver, etc.

750 cu. ft. 100# pres. Chic. Pneu. 2 stage Type OCE 17 & 10 x 12".
356 cu. ft. 100# pres. Chic. Pneu. 12 x 10.
245 cu. ft. 100# pres. Ing. Rd. ERI, 10 x 10.
175 cu. ft. 100# Pres. Chic. Pneu. 9 x 8.
164 cu. ft. Ch. Pneu. Steam Type.

ENGINE & TURBINE UNITS

50 KW West.—Turbo 125 v.
75 KVA G.E. 110/220/440/3/60 1200 RPM G.E. Diesel Eng., auto. control.
300 KW West. 125/250 v. DC—West. Turbine.

SYN. CONDENSER

1250 KVA West. Unused 3 ph. 60 cy. 1200 RPM. now 440 v. but can be rewound.

DC MOTORS

HP	Make	Voltage	Wdg.	Speed
7½	West. SK 43	230	sh.	1150
7½	Al. Ch.	230	sh.	350/1050
10	West. SK 43S	115	sh.	1750
10	West. SK 60L	230	sh.	1150
10	G.E. CD	230	sh.	1750
10	West. SK 80	230	sh.	730/1460
10	Cr. Wh.	230	sh.	500/1500
13	West. SK 113	230	sh.	875
15	West. SK 110	230	cp.	750
15	West. SK 83	230	cp.	950
15	Cr. Wh. CM	230	sh.	1400/1700
20	Cr. Wh. CMC	230	sh.	1200/1700
20	G.E. DLC	500	sh.	400/1200
20	West. SK 110	230	sh.	900
25	West. S	230	sh.	325/975
25	West. K5	230	ser.	500
25	West. SK 113	230	cp.	900
30	West. SK 93	230	sh.	1750
40	G.E. RC 34	230	sh.	750
50	West. S	230	cp.	875
60	Rel. T461	230	sh.	800/1200
125	West. SK 193	230	sh.	450/1000
375	West.	230	cp.	430/860

DC MAGNETIC MOTOR STARTERS

5—10 HP 230 v. Mag. Rev. Dyn. Braking.
1—25 HP C.H. 230 v. Dripproof.
4—30 HP EC&M. 230 v. Magnetic.
3—40 HP 230 v. W.L. Dripproof.
1—50 HP 230 v. C.H. Dripproof.
4—60 HP 230 v. C.H. Dripproof.
4—60 HP 115 v. W.L. Dripproof.
4—75 HP 230 v. C.H. Dripproof.
1—100 HP 230 v. C.H. Dripproof.
1—150 HP C.H. 230 v. Dripproof.

REDUCTIONS UNITS

500/700 HP Morse Chain Drive. 4.28 to 1.
300 HP V Belt dr. pulleys 30" and 48" supported by 2 roller bgs. with pedestals.
150 HP Nuttall 1.6 to 1.

AC MAGNETIC STARTERS

6—43¼ Clark Mche. Tool Mag. 440 v. 25 cy.
2—700 HP. West. 2200 v. Syn. Line Starters.

Power Equipment Engineers for Over a Quarter Century

MOORHEAD ELECTRICAL MACHINERY CO.

30th and Brereton Sts. **Pittsburgh 19, Pa.**

THESE UNITS CHECKED — RELIABLE — AVAILABLE NOW

TURBO GENERATORS

Non-Condensing

ITEM No. 952: 1500 KW, 480 volt, non-condensing turbo generator. ISP 185#, 500° F. T.T., 40# gauge back pressure. Built about 1936. Moore turbine, Form 5-T. Water rate: 1000 WK, 53#/KWH; 1500 KW, 46.1#/KWH; 2000 KW, 43.2#/KWH.
Generator GE, 1500 KW, .8 PF, 60/3/480 volt, direct connected 18½KW exciter; entire generator rewound 1945. Condition reported excellent.

ITEM No. 891: 1000 KW, 480 volt, non-condensing turbo generator. ISP 400# gauge, 700° F. T.T., 10# gauge back pressure, 60/3/480 volt. Built about 1924.
Westinghouse turbine single impulse wheel type. Turbine satisfactory for operation at 325 psig and up to 400 psig. Typical water rate: at 325 psig, 625° F. T.T., 16.7# absolute back pressure, and at full load 24.4#/KWH.
Generator recently rewound, complete with direct connected exciter. Condition reported excellent.

TURBO GENERATORS

Condensing Extraction

ITEM NO. 432: 500 KW turbo generator, extraction condensing. One 500 KW Moore-Allis Chalmers, ISP 150#, 486° T.T., 60/3/480 volt, surface condenser, 10/25# g. extraction.
Turbo Data: 750 HP Moore, S/N 1200, built 1928. Exciter 25 KW, 125 volt.
Condenser Data: Wheeler, S/N 4100, 3 pass, surface.

TURBO GENERATORS

Condensing

ITEM NO. 1164: *General Description:* 1000 KW, GE turbo generator, 60/3/480 volt, ISP 150#, surface condenser equipped, built about 1922.

ITEM NO. 609: 6000 KW Turbo Plant—Condensing.
Two 3000 KW GE, 60/3/2400 volt condensing turbo generators, ISP 200#, 100° SH, built 1917; turbines rebuilt 1935 (GE).
Turbo: S/N 12,300, 4-stage. Rebuilt, rebucketed, renozzled 1935. Generator stators rewound 1938.
Condenser: Will be supplied new or rebuilt—surface condensers, pumps, ejectors, etc.

ITEM NO. 908: 5000 KW Turbo Generator—Condensing.
General Description: 5000 KW, GE, 60/3/2300 volt, ISP 160#, 100° SH.
Condenser Data: Surface condenser, built 1943, with new air ejector.
History & Condition: Built about 1920. Completely rebuilt and overhauled.

ITEM NO. 857: One 1500 KW, GE 60/3/2300 vot turbo generator, ISP 225#, 486° T.T. with surface condenser.
History & Condition: Built 1923. Operated until March 1, 1948.

ITEM NO. 58: One 750 KW, GE, 150# ISP, 60/3/2300 volt, with surface condenser.
Turbo Data: S/N 27,200, Curtis, Form B, 3 stage.
Generator Data: S/N 2,006,000, Type ATB-2, Form T.
Condenser Data: C H Wheeler, 2100 sq. ft.
History & Condition: Installed 1923, continuous operation to 1925, 12,000 hours from 1925 to 1929, then standby to 1939. Public Utility maintenance.

ITEM NO. 940-T: 600 KW, GE, Condensing Turbo Generator. 60/3/2400 volt, ISP 200#. Jet condenser equipped. Built about 1929. Turbine S/N 36,800. Excellent condition.

ITEM NO. 95: One 500 KW Westinghouse turbo generator, 60/3/2400 volt, 250# ISP, with surface condenser and auxiliaries. Built 1927—rebuilt 1939.
Condenser Data: Wemco, S/N 2700, 750 sq. ft., circulating and condensate pumps, motor driven, LeBlanc air ejector.

ITEM NO. 62: 300 KW Turbo Generator—Condensing.
300KW Wemco, 60/3/120/208 volt, ISP 150#, 27" vacuum, surface condenser and steam auxiliaries. Direct connected exciter.
Condenser Data: Surface type, size 800, with steam jet air ejector, motor driven condensate pump.
History & Condition: Built 1927. Late in 1941 entire set reconditioned by Westinghouse, including rewinding generator, renozzling turbine, balancing rotor. Supplied new bullgear, new oil pump for gears, new distribution panel. Unit never used since.

WATER TUBE BOILERS

ITEM NO. 889: *General Description:* One 250 HP, 200# Heine box header boiler with gas and oil burners, Diamond soot blowers, Enco steam atomizing oil burner, Coppus-Dennis Fanmix gas burner, 350 GPM boiler feed pump, and normal trim.

ITEM NO. 941: One 260 HP, 150# Murray box header longitudinal drum boiler, built about 1930.

ITEM NO. 1232: Two 332 HP, 160# B & W lowhead Stirling boilers, with complete controls and auxiliaries. Two Wemco single retort stokers, two Cash combustion controls, instrument panel with flow meters and draft gauges, two Copes feedwater regulators, one boiler fed pump. ASME and N. Y. Std. Excellent condition. Built 1937.

ITEM NO. 968: *General Description:* One 334 HP Vogt 4-drum boiler, 300#, 600° T. T., with puverizer and complete auxiliaries. Capacity 25/30,000#/hr., with rear water walls. Elesco superheater, Diamond soot blowers, complete trim, steel, etc. Installed 1939. Operated eight years.

ITEM NO. 601: One 30,000#/hr. (418HP) B & W integral furnace boiler, 425#, 750° T. T., pulverized coal fired, complete with forced draft burners, Clarage forced draft fan, Diamond soot blowers, Bailey flow meters and gauges. All trim. Built 1940. Laid up end of 1946.

ITEM NO. 691: *General Description:* One 484 HP, 235#, 100° SH, Springeld sectional header boiler with chain grate stoker, Foster superheater, Diamond soot blowers. Built 1930. Also available—460 HP, 250#, 100° SH, Lasker-Adams boiler with stoker.

ITEM NO. 3: *General Description:* 750 HP, 250 psig Union Iron Works, 4-drum, bent tube boiler, built 1927. 7-retort Westinghouse stoker, forced draft fan, Copes feedwater reguator, Hagan controls, Bailey boiler meter, 150 ft. steel stack, spare tubes, grates, etc. ASME and Pennsylvania Std.

ITEM NO. 490: *General Description:* 1000 HP Springfield sectional header boiler, built 1928; 225# allowed, 100° superheat. Boiler complete with structural steel for drum support and standard accessories, fittings, and trim. Now dismantled and ready for immediate shipment.

FIRE TUBE BOILERS

ITEM NO. 972: Two 200 HP, 150#, Titusville, Type XL self contained Fire Tube boilers, gas fired, complete. Two Webster gas burners, Type N.G.E., one steel stack 4' D x 70' high, breeching and connections. ASME, National Board, and Hartford stampings. Built 1936. Used less than 6 years.

ITEM NO. 941: Ten Cleaver Brooks and Cyclotherm Package Boilers, 10 HP, 400#/hr., 100# working pressure, for #3 oil firing. Condensate units, complete spare parts kits. Motors operate on single phase, 60 cycle, 110/220 volt. Built 1944. Some never used, all checked, overhauled, tested.

STOKERS and PULVERIZERS

ITEM NO. 811: Three Type E Single Retort Stokers. Single retort underfeed stokers, steam drive, nominal capacity 400 BHP each. Combustion Engineering Co., Type E.H.P., Class 10, Size 10'10", installed with 415 HP bent tube boilers. Furnace width 10'6" and 6'6" as set from floor to C. L. of bottom drum. Purchased and installed June 1943, out of service November 1944. Equipment reported complete and in excellent condition.

ITEM NO. 873: Westinghouse Single Retort Stoker (1943). Moving grate, side dump, underfeed stoker with steam drive, blower and controls. For use with 350 HP B & W type H boiler. Will develop 200% of boiler rating (24,000# steam per hour, 125# pressure) continuous and 250% for 24 hours. Allows 78.5% boiler efficiency at 100% of boiler rating. Clarage centrifugal blower with motor drive. Brooke combustion controls including pressure and furnace draft regulators. Built 1943. Used only 3 months. Controls still in original crate. Dimensions required—furnace width 10'0", depth 8'1½". Stoker front to face of bridge wall 9'7½".

ITEM NO. 953: Two B & W, Type E Pulverizers. Direct fired pulverizers. 4250# coal per hour each. New 1942. Rated 4250#/hr. each bituminous coal based on 78% thru #200 U.S. Sieve, 98% plus thru #50 U.S. Sieve. Blower fan, V-belt drive, feeder motors (60/3/440 volt), starters, Bailey feeder controllers, piping, airducts, temperature recorders, draft gauges, etc. Installed 1942. Operated 6 months. Equivalent steam capacity (estimated) 45,000#/hr. each.

TRANSFORMERS

60 Cycle Power and Distribution

ITEM NO. 828: *General Description:* One 2500 KVA, 60 cycle, 3 phase, 2400 to 480 volts, OISC, Outdoor.
Primary: 2400 volts with 2-2½% taps above and 2 below normal.
Secondary: 480 volts.
Designed and built 1946 to AIEE specs, using tank and frame of older unit. Delivered 1947 with standard NEMA guarantee (now expired). Never in service.

ITEM NO. 1150: *General Description:* Three 200 KVA, GE, 60 cycle, 3 phase, 4160 to 240/480 volts. Built 1942.
General Data: S/N 6,912,000, Type H.

TRANSFORMERS

60 Cycle Furnace

ITEM NO. 344 & 5: Two 4000 KVA Furnace Transformers (1943). Pennsylvania transformers, 22 KV primary, 92-228 volts secondary. Reactance 5% to 35%. Built 1942 and 1943. Indoor transformers, 4000 KVA, 40° C, oil immersed water cooled, motor operated primary tap changer. Separate steel core reactor.
History & Condition: #1 new 1942, under load 1 year. Excellent condition. #2 new 1943, never energized. Excellent condition.

ITEM NO. 673: 1000 KVA Furnace Transformer—3 Phase.
One 1000 KVA Kuhlman, 60 cycle, 3 phase, 7200 to 219/94 volts with reactor.
History & Condition: About 14 years old. Removed from service during war to make room for larger unit.

ITEM NO. 350: Unused 200 KVA Furnace Transformer—3 phase.
One 200 KVA Wemco, 60 cycle, 3 phase, 230 to 120/60 volts with reactor and voltage regulator. S/N 2,400,300, Type SL, OISC, indoor, L. Spec. 338173, cont. 55° C rise for alumina and magnesia melting furnace.
Impedance: Internally mounted iron core reactor increases normal reactance to 30% total reactance. Reactor has straight line characteristics up to 2½ times normal current. Unused. Never hooked up. Built 1938.

ENGINE GENERATORS

ITEM NO. 910: 600 KW Skinner Unaflow Engine with AC or DC Generator. One 900 HP steam engine, S/N 10,800, 29" x 36" heavy duty side crank automatic Universal Unaflow right hand, 150 RPM, ISP 150 to 200#, back pressure 5 to 10#.
Generator Data: DC—Wemco 600 KW, 250 volt, 2400 amps. 2 wire, 150 RPM. AC—Wemco 600 KW, .8 PF, 60/3/460 volt, 942 amps., 150 RPM. Type ES. Built 1927. Engine and two generators now connected together and operated as one unit. Can be sold separately.

ITEM NO. 803: 320 KW Steam Engine Generator, Condensing. Skinner Universal Unaflow Horizontal, 60 cycle, 3 phase, 440 volt, with surface condenser. Wheeler surface condenser. 750 sq. ft., 3-pass, with steam driven condensate pump and steam jet air pump. Built 1920. Original generator rotor replaced with split cast steel rotor. Condenser bought new in 1927.

Also DIESEL ENGINE GENERATORS, SURFACE CONDENSERS

PAUL STEWART & CO., INC.

UNION TRUST BUILDING — ***PHONE: MAIN 3427*** — **CINCINNATI 2, OHIO**

MOTORS • GENERATORS • TRANSFORMERS

MOTORS
3 PHASE—25 CYCLE—220 440 VOLTS

H.P.	Make	Type	Frame	RPM
50	Fairbanks Morse	H16B	Ball Bearing	750
75	Fairbanks Morse	H16C	B.B. Slipring	750
5	Gen. Elect.	IK	2200 volt	750
75	Gen. Elect.	IK		1500
100	Allis Chalmers			1450
150	Gen. Elect.	IK-17		365
150	Gen. Elect.	IK-16		480
150	Gen. Elect.	IM-16	Slip Ring	480
150	Allis Chalmers			1450
150	Gen. Elect.	KT	557	1455
400	Gen. Elect.	IM 17A	Slip Ring	730
500	Gen. Elect.	IK		485
600	Gen. Elect.	MT	Slip Ring	490
600	Westinghouse	CS		490

TRANSFORMERS
3—667 KVA New Transformers—O.I.S.C. 13,800 Volts Primary, 480 Volts Secondary, 1 Phase 60 Cycle with Taps —for June 1 delivery.

TRANSFORMERS
3—150 KVA Niagara OISC 2400/120/240 1 Phase, 60 cycle with Taps.
3—150 KVA Niagara OISC 2400/240/480 1 Phase, 60 cycle with Taps.
6—100 KVA Niagara OISC 2400/240/480 1 Phase, 60 cycle with Taps.
3—100 KVA Niagara OISC 2400/120/240 1 Phase, 60 cycle with Taps.
3—75 KVA Niagara OISC 2400/240/480 1 Phase, 60 cycle with Taps.
3—50 KVA Niagara OISC 2400/240/480 1 Phase, 60 cycle with Taps.

FREQUENCY CHANGERS
All Sizes in Stock. 60 cycle to 90 cycle. 100 cycle, 120 cycle, 180 and any other high cycle if desired.

HORIZONTAL & DUPLEX
Compressors & Vacuum Pumps after Coolers, Filters

25 CYCLE MOTORS
1—1270 HP. Gen. Elect. Synchronous Motor Type A.T.I. 3/25/2200 Volts 150 RPM.
1—1900 HP. Gen. Elect. Synchronous Motor Type A.T.I. 3/25/2200 Volts 150 RPM.

MOTOR GENERATOR SETS
2—350 KW General Electric Sets 250 Volts D.C. driven by 500 HP. 3 Phase 25 Cycle motors.

ROTARY CONVERTER
1—2000 KW Westinghouse Booster type Rotary Converter 230 Volt D.C.—3 to 6 Phase, 25 Cycle, 4600 Volt Transformer.

300 HP. COMPENSATORS
2—300 HP. Gen. Elect. Reduced Voltage manually operated Type CR1034, 3 Phase, 60 cycle, 440 volts. Floor Type with undervoltage and overload protection.
1—300 HP. Gen. Elect. Reduced Voltage manually operated Type CR. 1034 K 22 3 Phase 60 cycle 440 volts.

NEW MOTORS
300 New Gen. Elect. & Westinghouse Motors in stock from 1 to 100 H.P.

MOTORS
1—75 HP. Fynn-Weischel Syn. 3/60/440/1200 RPM.
1—100 Gen. Elec. Slipring Type I Form M., 3/60/440/900 RPM.
1—100 HP. Gen. Elect. Type K (New Motor) 3/60/440/1800 RPM.
1—100 HP. Westinghouse Slipring Type CW, 3/60/440/435 RPM.
1—100 HP. Westinghouse Motor Type CS-867A, 3/60/440/885 RPM.
1—100 HP. West. Slipring Type CW 3/60/440/1200 RPM.
1—100 HP. Gen. Elect. Slipring 3/60/440/1200 RPM.
1—200 Gen. Elect. Type KT. 572 3/60/440/600 RPM.
1—200 HP. Gen. Elect. Slipring Type I Form M. 3/25/440/500 RPM.
1—500 HP. Allis Ch. Slipring 3/60/2200/514 RPM.
1—500 HP. Gen. Elect. Type I Form K, 3/25/440/485 RPM.
1—600 HP. West. Motor Type CS, 3/25/550/490 RPM.
1—600 HP. Gen. Elect. Slipring Type MT, 3/25/550/490 RPM.

VARIABLE SPEED MOTORS
2—300/150 HP. General Electric Motors Type BTA.—3 Phase 60 cycle 440 volts 560/280 RPM with controls.

3 PHASE 550 VOLTS 25 CYCLE MOTORS
Write for our stock list of approximately 500—3/25/550 Voltmotors

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CL. 4758

TURBO GENERATORS — DIESEL GENERATORS — AIR COMPRESSORS
ROTARY CONVERTERS — TRANSFORMERS — PUMPS — WINCHES

2—300 K.W. A.C. TURBO GENERATORS—with Reduction Gear. TURBINE G.E.—400 lbs—W.P.—Condensing—Superheat —0°-50° R.P.M. 4873.
REDUCTION Gear—4873/1200.
GENERATOR—A.C. 450V—1200 R.P.M. —3 Phase—60 cycle P.F. .8—Complete with 40 K.W. Exciter 120V. D.C.
CONDENSER—Foster-Wheeler—400 sq. ft.

2—200 K.W.—350 H.P. G.M.-8-268A DIESEL GENERATORS. ENGINE 350 H.P.—8 cylinders—2 cycle—1200—6½"x7" Air Starting.
GENERATOR—200 K.W.—450 Volts-321 Amps.—3 phase—60 cycle complete with switchgear.

1—ROTARY CONVERTER—Westinghouse 500 K.W.—575 volts—D.C.—Output 3 phase—500 R.P.M.—25 cycle—Input Serial 197892.

1—ROTARY CONVERTER—Mfg. by G.E.—Type H.C.-8-1000-375—Form K Output—600 volts—1667 Amps—D.C.—1000 K.W. —Input—25 cycle 3 phase.

2—ROTARY CONVERTERS—2000 K.W.—Output—600 volts—D.C.—3333 Amps, Input—3 phase—25 cycle—375 R.P.M.

1—MOTOR-GENERATOR SET—MOTOR—550 H.P.—400 volts—600 amps. 3 phase—25 cycle. Westinghouse. GENERATOR—350 K.W. 150 volts—2333 amps—290 R.P.M.

2—ROTARY CONVERTERS — G.E. — Type HCC-8-1000 K.W.—Output—600 volts—900 R.P.M.—D.C.—Input—60 cycles—3 phase—400 volts.

1—TRANSFORMER—Westinghouse—13800/422 volts—1050 K.V.A.—Outdoor Oil Impedance 12.2%—60 cycles—3 phase.

1—TRANSFORMER—G.E. 13800/422 volts—1050 K.V.A.—Outdoor Oil Impedance 11.1%—60 cycles—3 phase

6—TRANSFORMERS — 750 K.V.A.—13200/449 volts—25 cycle—Single Phase

3—TRANSFORMERS—175 K.W.—13000/400 volts—25 cycle—Single Phase.

3—TRANSFORMERS—350 K.W.—13000/355 volts—25 cycle—Single Phase.

1—AIR COMPRESSOR—Steam Driven—Mfg by Ingersoll Rand, High Pressure Side—16x14x20; Low Pressure Side—25x23x20. Capacity 1800 C.F.M.—at 110 p.s.i.

2—AIR COMPRESSORS, Electric, Mfg by Ingersoll Rand. 2-stage. Size—8¼"x2¾" x5"-30 cu ft/min. at 250#. Driven by 15 H.P. 230 volt motor, 575 R.P.M.

1—G. E.—OIL LINE BREAKER—Type FKR-255R; Breaker rating 15000 volts—600 amps; Closing Coil—W.S.F. 6275085GI—105 volts—42 amps—D.C.; Operating Range 90-150 volts; Pot. Trip Coil—W.S.F. 6174582G5—48 volts—48 amps—D.C.

1—1000 G.P.M. DIESEL DRIVEN FIRE PUMP —Pump Gardener Denver; Engine Buda —6 cylinders—4½x5½ 1101 H.P.

1—DEEP WELL PUMP—Mfg. by Deming. 6 Bronze Impellors; 6 stage—vertical—Built 1942—Can be run by diesel or motor—Capacity—1000 G.P.M. Deming # Size 12.

10—SINGLE DRUM WINCHES—5 ton capacity—Size 7x10 mfg. by Clyde.

10—DOUBLE DRUM WINCHES—5 ton capacity—size 7x10. Mfg. by Clyde—Drum side by side—Single geared.

6—MARINE BOILERS From Liberty Ships—24000 lbs/Hr. 485 H.P.—Water tube—cross drum sectional header—220 lb. W. P. 4852 sq. ft. heating surface.

2—MARINE BOILERS—W. P. 475#—H. P. 244.1—2441 sq. ft. water tube—Express type—Fully equipped.

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THE BOSTON METALS CO.

313 EAST BALTIMORE ST. Phones CURTIS 1121—1272 BALTIMORE, MD.

SYNCH. CONVERTERS

300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM, 6 PH. 60 CY. TRANSFORMERS.

MOTOR GENERATORS

500 KW G.E. SYN 250 V. 2300/4000 A.C. 900 RPM. 3 PH. 60 CY.

500 KW G.E. SYN. 600 V. 2300/4000 A.C. 900 RPM, 3 HP. 60 CY.

400 KW WEST. SYN. 600 V. 2300/4000 A.C. 720 RPM, 3 PH. 60 CY.

300 KW G.E. SYN. 250 V. 2300/4000/440 A.C. 720 RPM. 3 PH. 60 CY.

250 KW G.E. SYN. 125/250 V 2300/4000 A.C. 720 RPM, 3 PH. 60 CY.

Each unit listed above is owned by us and is available now for immediate purchase.

WALLACE E. KIRK COMPANY

502 Grant Building, Pittsburgh, Pa.

FOR SALE

NEW 30 KW DIESEL GENERATOR SETS

6 cylinder Chrysler Diesel engines, direct connected to: 30 KW, 3/50/220/380 volts, alternators with direct connected exciters, mounted on steel base, including self contained panel, automatic voltage regulator and spare parts. Limited quantity.

ALJOHN DIESEL Co., Inc.

904 Pacific St., Brooklyn 16, N. Y.

Sterling 3-6515

BOILERS

10 to 1000 H. P.

NEW-USED RECONDITIONED

Steam, Gas and Electric Power Equipment

J. PARKER THOMPSON CO., INC.

507 FIFTH AVE., NEW YORK CITY

MURRAY HILL 7-6547-8-9

NETWORK TRANSFORMERS

19—150 KVA, GE, type Ht. late type, oil or pyranol cooled, 3 ph., 60 cy., 27060/125/216Y Mult or submersible type; attached to each transformer is GE automatic heavy duty network protector type MG-6 and heavy duty primary switch; complete with all accessories.

8—200 KVA, GE, type Ht. late type, oil or pyranol cooled, 3 ph., 60 cy., 27060/125/216Y Mult or submersible type; attached to each transformer is GE automatic heavy duty network protector type MG-6 and heavy duty primary switch; complete with all accessories.

PHILA. TRANSFORMER CO.

2829 Cedar St. Phila., Pa.

ELECTRICAL EQUIPMENT — REBUILT and GUARANTEED

MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

LARGE STOCK OF A.C. and D.C. MOTORS!

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	H.P.	Speed	Volts	Make	Type
1	3	1750	440	West.	CW-232C
1	5	580	220	G.E.	HI-9
6	7½	810	550	G.E.	MTC-5201
1	7½	575	220	G.E.	MT-522
2	10	1140	440	West.	HP-7A
2	10	570	220	G.E.	HI-11
2	11‡	810	550	G.E.	ITC-5008
2	15	1160	440	West.	CW-464C
2	15	570	220	West.	CW-646
1	18	680	440	West.	MW-316
1	20	860	440	West.	CW-638
1	25	1130	550	G.E.	MT-323
2	25	850	220	Wagner	BR
2	25	720	440	Wagner	22VBR
1	30	865	440	West.	CW-646
1	30	850	440	G.E.	MT-332
1	30	675	440	G.E.	MT-336
2	35	600	440	F-M	HV-H16A
2	40	865	2200	Al.-Ch.	ARY-223C
1	40	560	440	G.E.	MT-346
2	50	1150	440	G.E.	M-536
1	50	869	440	West.	HF-12A
5	52‡	550	220	G.E.	IQC-5013***
1	60	685	440	West.	CW-758
1	60	570	550	G.E.	MTC-5546
1	60	345	550	West.	CW
1	75	720	550	G.E.	MT-556
1	80‡	575	440	G.E.	MTC-5352
2	125	430	440	G.E.	H.-16
2	150	1750	440	G.E.	MTP-549
1	150	870	440	G.E.	MT-561
1	175	505	550	West.	CW-1002
2	200	600	550	G.E.	IM-17
1	200	495	2200	G.E.	IM-17A
3	250**	296	220/ 380††	West.	CW-20-53-15
3	300	900	140	G.E.	IM-17
2	300	880	2200	G.E.	IM-17A
1	300	514	550	G.E.	IM-17A
3	300**	360	440	West.	CW-20-53-15
2	350	880	2200	G.E.	IM-17A
1	400	505	550	West.	CW
1	700	720	2300/4000		West. CW

All 220 volt motors can be reconnected for 440 volts and vice versa.

‡Intermittent rating. ***2 phase.

**New. ††50 Cycle.

230 VOLT CONSTANT SPEED D. C. MOTORS

Qn.	H.P.	Speed	Make.	Type
22	2	850	West.	SK-20
20	3	1150	West.	SK-20
10	3	850	Reliance	Y-23T
25	3½	850	West.	SK-30
3	7½	1750/1310	West.	SK-43
2	7½	1150	G.E.	CDM-66
2	7½	875/1750	West.	SK-631
3	7½	850	G.E.	CD-75
10	10**	1750	Kimble	BA-324
5	10**	1150	Al.-Ch.	EB-80
1	10	850	West.	SK-83
10	13½**	600	West.	SK-93
5	15	825	West.	SK-90
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
11	20	750	West.	SK-1101
17	25	825	West.	SK-120
1	30	750	G.E.	RC
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	650	G.E.	RC-16
2	60	1750/1310	West.	SK-143
3	75	850	West.	SK-160
1	150	700	Al.-Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
10	1½/2	500/200	G.E.	CD-65
1	2	225/900	Reliance	78T
2	6	450/1800	G.E.	RF-9
6	5/7½	600/1800	G.E.	RA-30
5	10	400/1600	Reliance	T-92T
1	12½	280/840	West.	SK-130
10	12½**	600	West.	SK-93
1	20/25	300/1200	West.	SK-153
1	23/29	300/1200	G.E.	RF-13
1	30	400/1200	West.	SK-163
1	30/40**	400/1600	G.E.	CD-1236
1	35	500/1500	West.	SK-143
1	40/50	400/1600	Al.-Ch.	EB-147
1	75	500/1500	Cr.-Wh.	CCM
1	75	375/750	Cr.-Wh.	CMC-125H
3	100	225/900	G.E.	MPC-A
5	100	400/1200	Al.-Ch.	
1	100	320/960	West.	SK-200
1	175	230/750	West.	SK-220
2	375	350/500	G.E.	MPC

**New.

VARIABLE VOLTAGE DRIVES

40 HP. Reliance, Variable Voltage Drives, each Consisting of:

1—40 KW. 250 Volt, Induction M-G Set, with two auxiliary 5 KW generators and exciter.

1—40 HP. 400/1500 RPM, Frame 385T, 230 Volt, DC Motor.

With full magnetic control providing jog forward, jog reverse, run, fast, slow, and stop, and motor operated field rheostat.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy. Totally Enclosed Fan Cooled, Ball Bearing

Qn.	H.P.	RPM	Volts	Make	Type & Frame
2	½	1750	220	R&M(TE)	L-184
1	½	1725	440	G.E.	K 63
4	1	1140	220	Howell	A-204
4	1.5	1150	220	L.A. (TE)	IS-225
5	1.5	1140	440	West.	CS-225
1	2	1735	220	G.E.	K-224
4	2	1140	220	L.A.	JS-225Y
1	2	1100	440	West.	CS-225
1	3	3450	220	Howell	K-224
3	3	1160	440	L.A.	JS-254
1	5	3480	220	G.E.	K-225
2	5	1750	440	L.A.	JA-254
12	5	1730	440	G.E.	K-254
1	5	1720	440	Century	SCH-254
2	5	1165	440	L.A.	JA-284
5	7.5	1740	440	G.E.	K-284
1	7.5	1735	220	G.E.	KF-284
1	10	3480	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	10**	880	220	West.	CS-365-EXPF
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504

Splashproof, Ball Bearing

1	2	1735	440	G.E.	K-224
1	3	1160	440	L.A.	FS-254
23	5	1750	440	L.A.	FS-254
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
1	10	3480	440	G.E.	K-284
1	15	1175	440	L.A.	JA-365
4	15	1150	440	L.A.	FX-365
3	30	3520	440	L.A.	FX-3658
3	40	1175	220	G.E.	K-445
3	50	1760	440	L.A.	FX-445A
5	50	1160	220	G.E.	K-504
2	75	870	440	West.	CS-752-C
1	125	1770	440	L.A.	FX-1078Y
1	150	1775	440	L.A.	FX-1168
5	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	K-6335
1	200	885	440	L.A.	FS-1378

Open Type Motors

Qn.	H.P.	Speed	Volts	Make	Type
5	2	170	440	G.E.	KT-926
4	2	1160	440	West.	CS-93C
1	2	690	440	G.E.	KT-944
10	5	1740	440	West.	CS-232C
1	7½	3475	440	West.	CS
1	7½	1750	440	West.	CS-250C
3	7½	1165	440	G.E.	KT-952
2	7½	870	440	West.	CS-370C
5	10**	1760	440	L.A.	OGA-324
5	10**	1750	440	West.	CSP-324
3	10	1160	440	West.	CS-370C
1	10	865	440	G.E.	KT-502
1	15	3485	220	Reliance	AA-B3247
5	15**	1735	440	Century	SC-326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
5	20**	1750	440	Wagner	PP1-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-512
2	20	900	220	G.E.	FTR-522
1	25	1800	220	G.E.	KT-312
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	SCRB-356***
2	25	575	440	G.E.	KT-542
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3545	220	G.E.	KF-404S
3	40	1750	440	West.	CS-583C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	RP5-405
1	50	850	220	West.	CCL
2	60**	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-346
1	75	1160	440	West.	CS-662C
1	100	1765	2200	West.	CS-765A
1	100	690	220	West.	C
1	100	580	2200	G.E.	IK-15A
2	100	500	2200	West.	CS-930
1	100	495	2200	Al.-Ch.	AN
2	125	435	440	Al.-Ch.	AR
2	125	400	2300	G.E.	I-17-FR
1	150	1780	440	G.E.	K-547
2	200	1750	440	West.	CS-855S
2	200	580	550‡‡	G.E.	KT-5668
2	350	1750	2300	G.E.	K-559B3
1	500	1200	440	G.E.	KTP-567
1	700	1800	2300/4000	West.	CS-4-39D-12

All 220 Volt Motors can be Reconnected for 440 Volts and Vice Versa.

**New. ***2 Phase.

‡‡Reconnectable for 440 volts.

CRANE, MILL TYPE 230 V. D.C. MOTORS

Qn.	H.P.	Speed	Make	Type
2 (115 v.)	3½	700	G.E.	CO-1803
2	5½	760	West.	MCB-20
1 (new)	10	650	G.E.	MD-403-BE
1	15	630	West.	K-5
3	25	590	Diehl	TE
2	35	750	G.E.	CO-1828
3 (new)	35	600	West.	CK-9
1	50*	750	G.E.	CO-1829A
1	50	600	West.	CK-9
5 (new)	50	525	G.E.	COM-1830AE
1	59	470	G.E.	CO-2007
2 (new)	60	550	G.E.	COM-1831AE
4	65	450	G.E.	COM-1830

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment Is Located in Our Cleveland Warehouse. We Have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.

4521 HAMILTON AVE. CLEVELAND 14, OHIO

Reliably Rebuilt—YEAR Guarantee

A.C. Squirrel Cage Motors

H.P.	Make	Type	Speed
200	Al. Ch.		600
150	Al. Ch.		514
147	West.	25 cy.	715
125	El. Prod.	B.B.	1150
125	Al. Ch.		450
100	G.E.	KT	1800
100	West.	CS	1800
100	G.E.		1200
75	Al. Ch.		3600
75	G.E.	IK	1800
75	G.E.	KT-347	1200
60	G.E. (2)	KG	1800
50	Ideal	A	1150
50	G.E. (2)	XP	1800
50	E.D. (5)	TEFC	1800
25	West.	3S-364	3450

A.C. Clipring Motors

600	Cr. Wh.	25 cy.	480
100	Wagner	25 cy.	480
75	G.E.	IM	690
60	G.E.	TEFC	720
50	Al. Ch.	ARY	600
50	G.E. (2)		514
40	G.E.	IM	1200
40	G.E.	MT-352	600
30	West. (2)	CI	900
30	G.E.	MT-542	720

A.C. Synchronous Motors

600	G.E.		900
400	G.E. (4)	TS	600
2-200	Ideal		257
50	G.E.		1200

Generators

KW	Make	Speed
150	G.E.	600

D.C. to A.C. Gen.

KW	Make	D.C.	A.C.
25	G.E.	230	220
25	Star	115	120
25	Ideal	115	440
25	El. Mchy.	230	440
7½	Hertner	115	440
5	El. Spec.	110	110

230 V. Variable Speed D. C. Motors

H.P.	Make	Type	Speed
100	Rel.	1050T	400/1000
100	G.E.	CD173	400/1200
75	Cr. Wh.	CMC	375/750
60	G.E.	C	480/1100
55	Cr. Wh.	CMC	165/500
50	West.		250/1000
50	West.	SK	500/1500
40	G.E.	CD	500/1500
35	G.E.	RF	500/1500
25	G.E. (3)	RF12	500/1500
25	G.E.	RF13	400/1600
25	West.	SK140	400/1200
20	G.E. (2)	RF12	400/1200
15	West. (3)	SK93	600/1750
15	West.	SK93	600/1200
15	E.D.	10S	500/1500
15	West.	SK	250/1500
10	G.E.	RF10	600/1800
10	West.	SK	600/1200
10	G.E.	RF	400/1600
10	G.E.	RF	400/1200

230 V. D.C. Motors

150	G.E.	RC19	800
100	G.E.	CDP	1750
100	Al. Ch.		900
75	West.	SK180	475
75	West.	SK170	635
60	West.	SK160	680
50	West.	SK133	1300
50	Diehl	K10	850
50	West.	SK	750
50	West. (3)	SK160	585
40	G.E.	RC	1750
40	West. (2)	SK103	1750
40	G.E.	RC	1075
35	West.	SK	1150
30	G.E.	RC	1100
30	West.	SK	975
30	G.E. (2)	RC	775
30	West. (2)	SK143	575
30	G.E. (2)	RC33	775
25	Rel.	92T	1150
25	West. (4)	SK113	860
25	E.D.	10S	800
20	West.	SK60	1750
20	West.	SK83	1750
20	G.E.	CD	1200
20	Star (2)	SHB30	29

115 V. D.C. Motors

30	C.W.	CCM-FH	850
25	G.E.	CDM85	1800
25	G.E.	CDM95	1200
20	G.E.	CD83	1750
20	West.	SK110L	750

600 V. D.C. Generators

KW	Make	Speed
200	Cr. Wh.	900
30	Burke	1750
30	E.D.	1150

250 V. D.C. Generators

KW	Make	Speed
330	Elliot	1200
300	G.E.	1200
200 (3)	G.E. MPC	1200
150	West.	900
150	West.	1180
150	G.E.	600
50	G.E.	1200
30 (3)	G.E.	1750
30	Cont.	1200
25	G.E.	1200
15	G.E.	1750
10	Star	1750
7½	West.	1200
5	West.	1750

125 V. D.C. Generators

KW	Make	Speed
250	G.E.	720
150	Cr. Wh	1200
100 (2)	West.	900
100	G.E.	1200
100	El. Mchy.	1200
75	Cr. Wh.	1200
75	Hertner	1150
50	Sturt.	2800
40	Cent.	1450
20	Delco	1200
15	G.E.	1150
10	Rogers	1450
7½	West.	1200
5	G.E.	1750

Low Voltage D.C. Generators

Amp.	Make	Voltage
8000	H-V-W.	6/12
6000	Chandeysson	6/12
6000	M-B-O'C. (2)	6/12
5000	M-B-O'C. (2)	6/12
5000	Col.	8/16
2000	H-V-W.	6/12
1000	Chandeysson	6/12
1000	Col.	6/12
125	Hobart (8)	7½
1000	H-V-W.	12/24
300	Star	15
67	Cont.	15
750	Star	15
1000	G.E.	15
800	G.E	22/23
600	Rel.	24
134	West.	24
175	Cr. Wh.	25
550	Col.	27
1600	G.E.	30
800	G.E.	30
100	G.E.	30
200	West.	30
205	G.E.	32
1000	G.E.	33
205	G.E.	42
24	G.E.	44/54
75	G.E.	50/10
800	G.E.	50
1500	G.E.	50
400	G.E.	60
1500	Century	60
1500	El. Prod.	65
1000	G.E.	7

ONLY PARTIAL LIST—SEND FOR No. 15

EST. 1910 → L. J. LAND INC. ←39TH YEAR

New England Representative:
BOSTON, MASS.
411 Atlantic Ave.
Phone: Liberty 4300

146 GRAND STREET, NEW YORK 13, N. Y.
PHONE: CAnal 6-6976

South Western Representative
HOUSTON, TEXAS, 1400 Carr St., Phone: Charter 4-6558

Pennsylvania Office
READING, PENNA.
10th & Exeter Sts.
Phone: Reading 2-6866

500 KW FAIRBANKS-MORSE GENERATING PLANT

1—450 HP 6 cylinder Diesel engine, series 32-E-14, 300 RPM, direct connected to 375 KVA Fairbanks-Morse generator, 240 volt, 3 phase, 60 cycle.

1—300 HP 4 cylinder Diesel engine, series 32-E-14, 300 RPM, direct connected to 250 KVA Fairbanks-Morse generator, 240 volt, 3 phase, 60 cycle.

Installation is complete with switchboard, exciters, volt meters, starting equipment, synchronoscope. Woodward governors and cooling equipment. Units can be operated for inspection. Immediate delivery.

DENNY & CLARK
1923 W. NORTH AVENUE
CHICAGO 22, ILLINOIS

FOR SALE

2-74,000 BBL. CAP. STEEL STORAGE TANKS

DARIEN CORP.
60 E. 42nd St., New York 17, N. Y.

TURBO GENERATORS

375 KVA., 3 phase, 60 cycle, 450 volt Gen. Elec. 400 lbs. steam.
500 KW., 3 phase, 60 cycle, 440 volt Gen. Elec. #39937 with surface condenser, evactor, and switchboard.
750 KW. Gen. Elec., 150 lbs. steam, 10-20 lbs. extraction.
1000 KW., Gen. Elec., 190 lbs. steam up to 50 lbs. B.P. non condensing.

MOTOR GENERATORS

300 KW., 250 volt Gen. Elec. to a 435 HP., 3 phase synch. motor with boards.
100 KW., 125 volt Gen. Elec. to a 150 HP., 3 phase motor.
80 KW., 80 volt Burke with synch. motor and panels.
50 KW., 250 volt Westgh. to 3 phase synch. motor.

TRANSFORMERS

1—750 KW. Westgh. 13800 x 80 down to 60 volts.
2—150 KVA. Pittsburgh 2300 x 230/460 volt.
2—150 KVA. Pitsburgh 2400 x 120-240 volt.
4—100 KVA. Westgh. 13200 x 2200 volt.
3—100 KVA. Westgh. 13800 x 230/460 volt.
Over 100 NEW Gen. Elec. up to 75 KVA., 450 x 120 volt.

DC ENGINE GENERATOR

150 KW., 125 volt Crocker Wheeler to a 4 cylinder vertical Ames engine.

MOTORS

Large stock AC & DC motors

All above equipment actually in stock. Send for our list of many other items we have.

KEYSTONE
Power Plant Equipment Company

8403 Hegerman St. **Phila. 36, Pa.**

"BREW, WOLTMAN OFFERS"

TURBINE UNITS—60 Cy.

2—7800 KVA Gen. Elec. 25 Cycle Cond.
1—5000 KVA General Electric Cond.
2—3750 KVA Westinghouse Cond.
1—3125 KVA General Electric Cond.
1—2000 KVA General Electric Cond.
2—1250 KVA General Electric Cond.
2—1250 KVA Elliott Cond.
1— 600 KVA Allis Chalmers Cond.

STEAM ENGINE UNITS—60 Cy.

1—900 KW Hamilton Uniflow
1—450 KVA Ames Uniflow
1—375 KVA Harrisburg Uniflow
1—225 KVA Skinner Uniflow
1—187 KVA Ames Vertical
1—156 KVA Ames Vertical
1—150 KVA Harrisburg 4-valve
1—125 KVA Ames Uniflow

D.C. STEAM ENGINE UNITS

2—750 KW Skinner Uniflow, 250 V.
1—600 KW Skinner Uniflow, 250 V.
1—300 KW Skinner Uniflow, 275 V.
1—275 KW Ames Uniflow, 250 V.
1—200 KW Skinner Uniflow, 250 V.

DIESEL ENGINE UNITS

6—1600 HP Fair. Morse, 2400 V. 60 cy. gen.
1— 720 HP Amer. Loco., 2400 V. DC
1— 625 HP Worthington, 240 V. 60 cy. gen.
1— 480 HP Fair. Morse, 2400 V. 60 cy. gen.
1— 400 HP Fair. Morse, 2300 V. 60 cy.
1— 400 HP DeLaVergne, 2400 V. 60 cy.
1— 90 HP Fair. Morse, 240 V. 60 cy.
2— 30 KW Buda 6DTG-317, 3-60-127/220 V.

WATER TUBE BOILERS

1—2000 HP B. & W. 450#. Pulverized coal & oil.
1— 519 HP Titusville 200-lb. Stoker.
2— 509 HP B. & W. 200-lb. Stokers.
1— 500 HP Union City 400-lb. Pulverizer.
5— 492 HP Heine, 180-lb. Stokers.
2— 469 HP B. & W. 425-lb. Pulverizer.

SYNCHRONOUS MOTORS

2—3000 HP G. E. 60 cy. 2300 V. 257 RPM
1— 880 HP G. E. 60 cy. 6600 V. 514 RPM
3— 400 HP Elec. Mcy. 60 cy. 440 V. 600 RPM
1— 300 HP G. E. 60 cy. 2200 V. 600 RPM
1— 300 HP West. 60 cy. 2300 V. 900 RPM
1— 200 HP West. 60 cy. 440 V. 1800 RPM
4— 150 HP West. 60 cy. 2300 V. 400 RPM
1— 100 HP G. E. 2300 V. 240 RPM (Super)

INDUCTION MOTORS

1—8000/1000 HP Cr. Wh. S/R 2200 V. FL 895/448 RPM
1—1200 HP Allis Chalmers S/R 2200 V. 440 RPM
1—1000 HP West. S/R 2200 V. 360 RPM
1— 800 HP Allis Chalmers S/R 2200 V. 440 RPM
3— 350 HP Elliott S/C 2300 V. 900 RPM
1— 300 HP West. S/R 2200 V. 1800 RPM
3— 200 HP Elec. Mcy. S/C 480 V. 1800 RPM
1— 200 HP G. E. S/R 2200 V. 435 RPM
1— 150 HP Cr. Wh. S/C 440 V. 1800 RPM. NEW.
1— 150 HP Burke S/C 440 V. 1800 RPM. NEW.
1— 150 HP Al. Ch. S/C 440 V. 1200 RPM
1— 60 HP West. S/C 2300 V. 1200 RPM

MOTOR GENERATOR SETS

1—1800 KW Gen. Elec. 250 V. DC 60 cy.
1—1500 KW Allis Chal. 600 V. DC 60 cy.
2—1000 KW Gen. Elec. 600 V. DC 60 cy.
1—1000 KW Gen. Elec. 275 V DC 60 cy.
1— 750 KW West. 250 V. DC 60 cy.
1— 500 KW Cr. Wh. 600 V. DC 60 cy.
1— 500 KW Gen. Elec. 250 V. DC 60 cy.
1— 400 KW Allis Chal. 275 V. DC 25 cy.
2— 300 KW Allis Chal. 275 V. DC 25 cy.
1— 200 KW Gen. Elec. 60 V. DC 60 cy.
2— 150 KW Elec. Mcy. 250 V. DC 60 cy.
2— 75 KW Star 240 V. DC 60 cy.
1— 75 KW West. 125 V. DC 60 cy.
1— 50 KW West. 125 V. DC 60 cy.

ROTARIES—60 Cy.

1—2925/3705 KW Gen. Elec. 225/285 V.
1—2025/2565 KW Gen. Elec. 225/285 V.
1—2000 KW Allis Chalmers 600 V.
2—1500 KW Westinghouse 270 V.
1—1500 KW Westinghouse 600 V.
2—1000 KW Gen. Elec. 600 V.
1—1000 KW Westinghouse 240 V.
1— 750 KW Westinghouse 275 V.
1— 750 KW Gen. Elec. 600 V.
1— 500 KW Allis Chalmers 600 V.
1— 500 KW. Gen. Elec. 275 V.
2— 300 KW Westinghouse 250 V.

FREQUENCY CHANGERS

1—6250 KVA G. E. 50/60 cy. 600 RPM
1—2150 KVA G. E. 25/62½ cy. 750 RPM
1—1875 KVA G. E. 25/60 cy. 300 RPM
2—1000 KVA G. E. 25/60 cy. 300 RPM
1— 500 KVA West. 25/62½ cy. 750 RPM

TRANSFORMERS—60 Cy.

3— 833 KVA Al. Ch. 33000—4800 V.
3—3750 KVA West. 26400/13200—2400 V.
1—8000 KVA Penn. Auto 26400/13200—2400 V. 3 ph.
4— 333 KVA Al. Ch. 25410/44000—13280/23000 Y
3— 750 KVA West. 22000—2300/4600 V.
3— 134 KVA G. E. 14400—2400 or 480 V.
3— 150 KVA Moloney 11000—2300 V.
3— 167 KVA G. E. 7200/12400 Y—2400 or 480
1—1500 KVA West. Auto 4000—2300 V. 3 ph.
3— 167 KVA G. E. 2400/4160 Y—120/240 V.
1—2500 KVA West. 2400—480 V. 3 ph.
1— 100 KVA G. E. 2300—575 V. 3 ph.
3 20 KVA West. 2200—575/287½ V.

OIL CIRCUIT BREAKERS

1— 400 A. 37 KV West. GII		Outdoor
2— 400 A. 25 KV G. E. FK0136		Outdoor
2—1000 A. 23 KV Kelman CB76		Outdoor
4— 600 A. 15 KV FHK0139-24BS		Outdoor

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BREW, WOLTMAN & CO., INC.

50 Church Street New York City 7, New York

FOR SALE

1—750 HP Busch Sulzer 4 cyl. 2 cycle 180 RPM. 500 KW GE 3/60/440 gen. Complete installation. All accessories. Condition excellent.

2—700 HP Sterling water tube boilers 4 drums 425# pressure. Water walls, Superheaters, etc.

MISSISSIPPI VALLEY EQUIPMENT CO.
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STEAM TURBO UNIT

60 CYCLE

For Immediate Delivery

1—3000 K.W., 3750 KVA. Westinghouse CW 46, 2 Stage Reaction Type Single Flow Condensing Turbo 150/200# steam pressure, Alternator 3 phase, 60 cycle, 2300 volts, 3600 RPM.

Unit recently entirely overhauled by manufacturer.

ARCHER & BALDWIN, INC.
(Inc. 1917)
75 West Street, New York, 6, N. Y.

POWER PLANT EQUIPMENT

Special Offerings

TURBO-GENERATORS

1—3500 KW 2300 V. Cond
1—3000 KW 600 V. Cond
2—2500 KW 440 V. Cond
1—2500 KW 2300 V. Cond
1—2000 KW 600 V. Cond
1—1500 KW 2300 V. Cond
1—1500 KW 600 V. DC Cond
2—1250 KW 2300 V. Cond
2—1000 KW 480 V. Extrac.
1—1000 KW 2400 V. Cond
1— 750 KW 2300 V. Cond
1— 600 KW 240 V. Cond
1— 500 KW 600 V. DC Cond
1— 500 KW 480 V. Cond
1— 500 KW 480 V. Extrac.
1— 250 KW 2300 V. Cond
1— 150 KW 2400 V. N. C.
2— 125 KW 220 V. N. C.
1— 125 KW 600 V. Extrac.
1— 50 KW 220 V. N. C.

BOILERS

1—150,000# 450# New
1— 30,000# 400#
1— 30,000# 425#
1—1030 HP 225#
4— 500 HP 200#
2— 500 HP 175#
2— 500 HP 400#
2— 480 HP 225#
2— 400 HP 180#
1— 400 HP 200#
1— 300 HP 200#
2— 250 HP 160#
1— 175 HP 15#
3— 158 HP 150#

TRANSFORMERS

3—667 KVA —2300/460
3—500 KVA 11,000/460
3—500 KVA 13,800/575
3—200 KVA 600/220/110

ENGINE-GENERATORS

1—375 KW 2300 V. Uniflow
1—168 KW 600 V.
1—168 KW 220 V. Uniflow
1—150 KW 240 V.
1— 75 KW 240 V. Uniflow

AIR COMPRESSORS

1—6000 CFM 50# Motor
2—5600 CFM 50# Motor
1—1200 CFM 100# Motor
1— 700 CFM 100# Motor
1— 400 CFM 100# Steam
1—6000 CFM 5.1# New
1—5000 CFM 10# Rotor Type Syn. Motor 440 V.

BELTED GENERATORS

1—520 KW 360 RPM —550 V.
1—500 KW 225 RPM 550 V.
1—350 KW 300 RPM 550 V.
1—180 KW 600 RPM 550 V.

Write or wire for additional data and prints.

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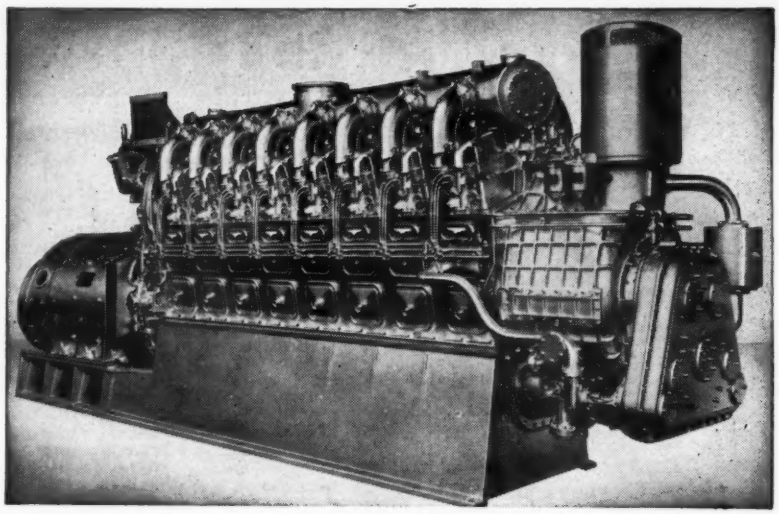

PORTABLE POWER PLANTS

15 KW INTERNATIONAL HARVESTER UD-9, 18.75 KVA, 3 PHASE, 50° cycle, 127/220† volts, 6 wire, 1000 RPM, direct connected Electric Machinery generator and exciter mounted on structural steel skid base. Complete with "package" type switchboard, remote starting feature, tools, muffler and batteries.

OTHER UNITS AVAILABLE

hp	Model	kva	kw	rpm	Gen.	Phase	Cycle	Volts
1—270	Hercules DNX	125	100	1800	G. E.	3	60	127/220†
2—125	General Motors 6-71	75	60	1200	G. E.	3	60	127/220†
2— 52	International UD-14	37.5	30	1200	Century	3	60	127/220†
1— 52	General Motors 3-71	37.5	30	1200	Delco	3	60	127/220†

*Suitable For 60 Cycle Service. † Other Voltages On Request.

STATIONARY POWER PLANTS

1000 KW G.M., 1250 KVA 0.8 P.F., 3 ph., 60 cy., 2400/4160, 4 wire, 720 RPM (830 KW, 1040 KVA, 3 ph., 50 cy., 3500v., 600 RPM, 16-278A, 1000 KW General Motors)

OTHER UNITS AVAILABLE

hp	Model		kva	kw	rpm	Gen.	Phase	Cycle	Volts
2—1600	General Motors	16-278A	1250	1250	720	G.E.	3	60*	2300
2—1600	General Motors	16-278A	1250	1000	720	Elliott	3	60*	2400/4160
4— 450	Enterprise DSG-6		375	300	450	West.	3	60	2400/4160†
4— 450	Enterprise DSG-6		——	250	450	Elliott	—	DC	120/240

* Suitable For 50 Cycle Service. † Other Voltages On Request.

Diesel Motors

WE HELP TO LIGHT AND POWER THE WORLD

PORT WASHINGTON, L. I., N. Y. CORPORATION TEL: PORT WASHINGTON, 2000

TURBO GENERATORS

TURBINE OF THE MONTH

1—1500 KW G.E. 2300v, 3 ph., 60 cy. with G.E. 225 lbs. cond. turbine, surface condenser

1—3000 KW Whse. 3750 KVA, 2300v, 3 ph., 60 cy. with Parsons 200 lb. cond. turbine

1—2000 KW G.E. 6600v, 3 ph., 60 cy. with 175 lb. cond. turbine and dir. conn. exciter

1—1500 KW Whse. 480v, 3 ph., 60 cy. with 160/175 lbs. Surface Condenser, panel & exciter

1—450 K.W. Whse 250 lbs. I.S.P. Surface Condensers—Auxiliaries—3 phase, 60 Cycle, 440 Volts. Direct connected Exciter Equipment built 1944.

2—1250 KW G.E. 2300v, 3 ph., 60 cy. with 175 lbs. condensing turbine

1—1250 KW Al Ch. 2300v, 3 ph., 60 cy. with 200 lb. condensing turbine, surface condenser

1—1000 KW G.E. 2300/4150v, 3 ph., 60 cy. with 135/150 lb. condensing turbine

1—500 KW G.E. 480v, 3 ph., 60 cy. dir. conn. exciter with 80/100 lbs. I.S.P., 10/15 lbs. B.P., non-condensing turbine

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43 HOWELL ST. JERSEY CITY 6, N. J.

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ALSO N. Y. CITY LINE—RECTOR 2-7150

AVAILABLE

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TURBO GENERATORS

1—3750 KVG G.E. 480 V. Cond.
1—2500 KVA West. 2300 V. Cond.
1—1250 KVA G.E. 480 V. Mix Pres.
1—187.5 KVA West. 240 V. Non Cond.

ENGINE GENERATORS

2—575 KVA Skinner Unaflow 220 V.
1—575 KVA Allis Chalmers Corliss 480 V.
1—156 KVA Ames Vertical 480 V.
1— 60 KVA Murray Corliss 220 V.

BOILERS

1—850 HP Sterling 250# 550° TT superheat

DIESEL ENGINES

2—100 KW Gen. Mtrs. 440 V.
2—400 KW F&M 2400 V.
1—NEW Buda 75 KVA 120/240 V. Not Surplus.

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For Complete Specs.

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FOR SALE

315 HP Sterling Water Tube
ASME 160# Pressure Boiler

NELSON MACHINERY COMPANY
Green Bay, Wisconsin

ASME BOILERS Nat'l Bd.

2—404 HP sectional steel header cross drum Springfield, 10' settings, oil fired.
2—25,000# (normal rating) Stirling's pulverizers, 425#.
2—400 HP sectional header, underfeed stokers.
1—300 12' settings, 7 years old, stack & breeching for these 3 units.

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3423-91st. Street Jackson Heights, N. Y.

NEW & REBUILT EQUIPMENT

FOR IMMEDIATE DELIVERY

COMPLETE BOILER PLANT

Erie City Boiler, 45,000# per/hr., 180# pressure, ASME Code. Pulverized coal fired. Excellent condition.

AIR CONDITIONING UNITS

1—Frigidaire—20 ton capacity.

1—Carrier—30 ton capacity.

DIESEL ENGINES

3—Buda, Model 6LD468, 68 H. P.

1—Hercules, Model DWXDS, 150 H. P.

AIR COMPRESSORS

Ingersoll Rand, type 40, 7" x 6¼" x 5", 194 CFM, 100# W. P., 40 H. P., TEFC, 3/60/220/440 volts with Control. New 1942.

Worthington, 14 x 13, 628 CFM, 100# W. P., 100 H. P., Synchronous Motor, 3/60/220 volts with Controls. New 1942.

BUCKET ELEVATORS

3—46', 48', 68' Centers.

DIESEL LOCOMOTIVES

1—45-ton, General Electric-Cummins Standard Gauge.

MISCELLANEOUS

REDUCERS — Philadelphia, Farrell-Birmingham, Cleveland, etc. Up to 75 H. P.

PUMPS — Duriron, Allis Chalmers, etc. Up to 2000 GPM.

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MOTORS—NEW ¼ H. P. to 125 H. P., X. P., TEFC, Open.

AIR RECEIVER—5' diam. x 14'.

STEEL STORAGE COAL BIN—275 ton, riveted.

WELDERS—300 and 400 amps., Gen. Electric and Hobart.

TRANSFORMERS—7½ KVA TO 500 KVA.

Heat and Power Co., inc.

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New or Re-Built

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Portable—Stationary

All Makes & Sizes

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45 Years of SERVICE

PUMPS—Motor Driven—Centrifugal

1—2500/1500 GPM-50/64 Ft. Head Goulds, 12" S., 10" D.—40 H.P. 1140 RPM Motor.
1—1400 GPM—40 Ft. Head DeLaval, 8" S., 8" D.—25 H.P. 1750 RPM Motor.
1—1000 GPM—65 Ft. Head Lawrence, 8" S., 6" D.—30 H.P. 900 RPM Motor.
1—500 GPM—25 Ft. Head Frederick, 5" S., 4" D.—5 H.P. 1750 RPM Motor.
1—500/200 GPM—48/75 Ft. Head Goulds, 4" S., 4" D—10 H.P. 1750 RPM Motor.
1—450/100 GPM—60/90 Ft. Head Worthington—4" S., 3" D.—10 H.P. 1750 RPM Motor.
1—100 GPM—50 Ft. Head BRONZE Lawrence, 3" S., 2" D.—5 H.P. 1150 RPM Motor.

ALSO

1—300 H.P. Westinghouse Type CS, 3 ph., 60 cy., 2200 v., 1750 RPM, Squirrel Cage Motor.

DELTA EQUIPMENT CO.

148 N. 3d St., Phila. 6, Pa.

POWER EQUIPMENT

NORTHERN METAL COMPANY — TRIPS IN DEPENDABILITY

DIESEL ENGINES **DIESEL GENERATORS**

TURBO GENERATORS

WE HAVE ON HAND ONE OF THE LARGEST INVENTORIES OF POWER EQUIPMENT IN THE EAST . . . . . .

MOTOR GENERATORS - STEAM ENG. GENERATORS - CENTRIFUGAL FANS - CENTRIFUGAL PUMPS - ROTARY PUMPS - RECIPROCATING PUMPS - MACHINE TOOLS - MOTORS A-C D-C - AIR COMPRESSORS

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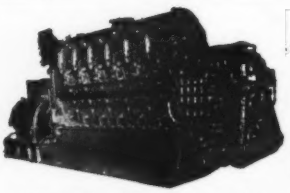
ALTERNATORS, ALL FREQUENCIES
TRANSFORMERS, LARGE STOCK
D.C. GENERATORS, ALL VOLTAGES
CONTROL EQUIPMENT

ALL SIZES
VOLTAGE AND CYCLES

3 ph. 60 cy. A.C. Motors
3 ph. 25 cy. Motors
125 Volts D.C. Motors
230 Volts D.C. Motors
550 Volts D.C. Motors

THE FRED W. KIEMLE CO., 33 N. SUPERIOR ST., TOLEDO 4, OHIO

Put all idle equipment to work. Send your list for prompt action. WRITE OR WIRE YOUR INQUIRIES



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1000 KW, 2400 Volts, 3 Phase, 60 Cycle, 720 RPM, General Motors Model 16-278A
750 KW, 2400 Volts, 3 Phase, 60 Cycle, 720 RPM, General Motors Model 12-567
600 KW, 2400 Volts, 3 Phase, 50 Cycle, 600 RPM, General Motors Model 12-567
300 KW, 450/2400 Volts, 3 Phase, 60 Cycle, 1200 RPM, General Motors Model 8-268A
200 KW, 450/2400 Volts, 3 Phase, 60 Cycle, 1200 RPM, General Motors Model 8-268A
125 KW, 220/440/2400 V, 3 Ph, 60 Cy, 1200 RPM, General Motors Model 3-268A
125 to 900 HP Diesel Driven Right Angle Pump Drive Units 900 to 1800 RPM.
75 KW, 220/440 Volts, 3 Phase, 60 Cycle, 1200 RPM, Hercules Diesel DFXE
50 KW, 440 Volts, 3 Phase, 60 Cycle, 900 RPM, Fairbanks-Morse Model 36A 5½
100 KW, 3 Wire, 125/250 Volts DC, 1200 RPM, General Motors Model 3-268A
900 HP, General Motors Model 12-567, Propulsion Unit Complete

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THREE WIRE D.C. GENERATORS

1—500 KW Whse reduction gear turbo-generator unit, type 6 EHNC, non-condensing, compound interpole, good commutator 125/250 V.

1—750 KW Whse generator only, single bearing, 550 RPM, compound interpole, 125/250 V. Splendid condition.

PHILADELPHIA TRANSFORMER CO.
BOX 566 — DALTON, PA.

O. E. T. CRANES

24 Ton 37' Span 5 Motor
20 Ton P&H 37' Span 3 Motor
12 Ton Wood 37' Span 3 Motor

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60 E. 42nd St., N. Y. 17, N. Y.

TRANSFORMERS

FOR SALE

2—150 KVA. 60 CY. 1 PH. 2400-240/480 SCOTT TAPS.
6—100 KVA. 60 CY. 1 PH. 2400-240/120
6— 75 KVA. 60 CY. 1 PH. 2400-240/120
9— 50 KVA. 60 CY. 1 PH. 2400-240/120
7—37½ KVA. 60 CY. 1 PH. 2400-240/120
8— 15 KVA. 60 CY. 1 PH. 2400-480/240.

ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

ATLANTIC TRANSFORMER CO.
5143 N. 2nd St. — Philadelphia 20, Pa.

BOILERS

Locomotive type, portable with oil burners. 73 to 110 h.p., 150-lb. pressure.

National Boiler & Equipment Co.
1501 South Senate Avenue
Indianapolis 5, Indiana

FOR SALE

1—250 KW GE turbo-generator unit. Steam conditions 525#, 350° superheat, condensing. Generator 3-phase, 60 cycle, 450-volts, 1200 RPM with 40 KW exciter.

Machine New in 1941

G. DeRose
408 Donovan Bldg. Detroit, Mich.

SELF-CONTAINED BOILERS

135 H.P. Erie Economic A.S.M.E., 150# pressure, with or without stack.
90 H.P. Keeler, A.S.M.E., 125# pressure.
2—75 H.P. Leffel Scotch, A.S.M.E. 125# pressure.
35 H.P. Erie Economic, A.S.M.E., 100# pressure.

All reconditioned. Immediate delivery.

M. J. HUNT'S SONS
1600 N. Delaware Ave. — Phila. 25, Pa.

FOR SALE

One—500 KVA, 480 volt,

3 Phase, 60 Cycle, 150 RPM.

ALLIS-CHALMERS GENERATOR

Direct connected to 18" x 36" Allis-Chalmers Corliss type steam Engine, 200 Psig. initial pressure, 30 psig back pressure. Engine equipped with tail-rod and Nugent Oil System. Complete with switch board and belted exciter. Excellent condition. Price $6,300 f.o.b. Hartsville, S. C.

SONOCO PRODUCTS COMPANY,
HARTSVILLE, S. C.

SLIP RING MOTORS

3-Ph., 60 Cy.

HP	Volts	Make	Speed
200	2200/440	G.E.	600
200	2200/440	G.E.	1200
200	440	G.E.	450
150	550	G.E.	720
150	2200/440	G.E.	1200
125	440/220	G.E.	600
125	440/220	G.E. (Hoist)	900
100	2200/550	G.E.	1800
100	440/220	G.E.	720
100	2200/440	G.E.	600
80	440/220	G.E. (MTC)	900
75	2200/550	G.E.	1800
75	2200/550	G.E.	900
50	440/220	G.E.	900

SYNCHRONOUS MOTORS

3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	600
300	2200/440	G.E.	ATI	600
250	440/220	Whse.	HR	277
200	4150/2300	Whse.	G	1800
150	4150/2300	G	G	1800
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	G.E.	TS	900
100	440/220/25 cy	G.E.	TS	375
100	440/220	Whse.	G	1800
75	440/220 (new)	Whse.	G	1800
75	2200/440	Wbse.	GE	600

TURBO GENERATOR

Generator, 125 kva. 1200 rpm., 440/220 v., Whse., dir. conn. by reduction gear to Turbine, 100 kw. 7380 rpm. non-condensing, 150/200 lbs. ga. pr., complete with dir. conn. exciter and switchboard; practically new condition, never used.

AIR COMPRESSOR UNIT

1—13" and 8" by 10" Worthington FEATHER-VALVE, 285 rpm, 110 lbs. ga., motor-driven, complete

CIRCUIT BREAKERS

1—5000 amp., ITE, 3 pole, 600 v., air
1—4000 amp., ITE, 3 pole, 600 v., air
2—2000 amp., G E, 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
600	2300/440	G.E.	KT	1200
500	440/220	G.E.	IK	900
400	550	G.E.	IK	720
350	2200/440	Whse.	CS	600
300	2200/440	Whse.	CS	600
200	440/220	G.E.	TEFC	1800
200	2200/440	G.E.	KF	720
200	2200/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
150	440/220	Howell	B. Brg.	1800
150 vert.	440/220	G.E.	KTP	1200
125 vert.	440/220	G.E.	KTP	1200
125	440	G.E.	KT	600
100	440/220	G.E.	KT	450
100	2200/440	G.E.	K	1200
100	2200/550	G.E.	KT	900
75	440	G.E.	KT	400
60	440/220 (new)	L. Allis	OGA	1800

A. C. GENERATORS

1—320 kva., 600 rpm., 440/220 v., G.E.
1—300 kva., 600 rpm., 2200/440 v., G.E.
1—150 kva., 1800 rpm., 2200/550 v., Whse.
1—112 kva., 900 rpm., 440/220 v., G.E.
1— 98 kva., 1800 rpm., 440/220 v., G.E.
2— 75 kva., 1800 rpm., 440/220 v., Whse.
1—62½ kva., 1200 rpm., 440/220 v., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
200	230	Cr. Wh.	CMC	890
150	230 (new)	Cr. Wh.	TEFC	900
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230 (new)	Whse.	SK	1150
75	230	Whse.	SK	850
75	230	Whse.	SK	1750

MOTOR GENERATOR SETS

1—250 kw., 250 v., 1200 rpm., Cr. Wh., conn. to 300 kva., 4000/2300 v., 3 ph., syn. motor.
1—150 kw., 250 v., 1200 rpm., conn. to 250 hp., 440/220 v., 3 ph., sq. cage Whse. motor.
1—100 kw., 250 v., 900 rpm., Cr. Wh., conn. to 150 hp., 440/220 v., sq. cage.
1—75 kw., 125 v., 1200 rpm., G.E., conn. to 120 hp., 2200/440 v., syn. motor.
1—75 kw., 250 v., 1200 rpm., Whse., conn. to 112 hp., 440/220 v., sq. cage motor.
1—50 kw., 250 v., 1200 rpm., G.E., conn. to 75 hp., 440/220 v., 60 cy. G.E. syn. motor.
1—50 kw., 125 v., 1200 rpm., Whse., conn. to 75 hp., 440/220 v., 60 cy., syn. motor.

TRANSFORMERS

60 Cycle

1—1000 kva., Al. Chal., 2400-120/240/208 volts, 3 phase. NEW.
1—500 kva., G.E., 2400/4150Y-240 v., 3 ph., unused.
1—400 kva., G.E., 2300-230/115 v.
3—200 kva., Whse., 7200/12400Y-240/480 v., 1 ph.
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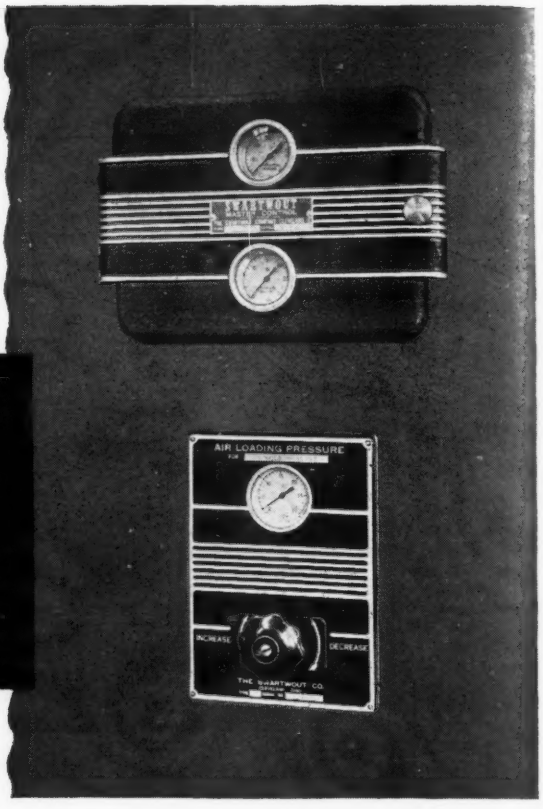
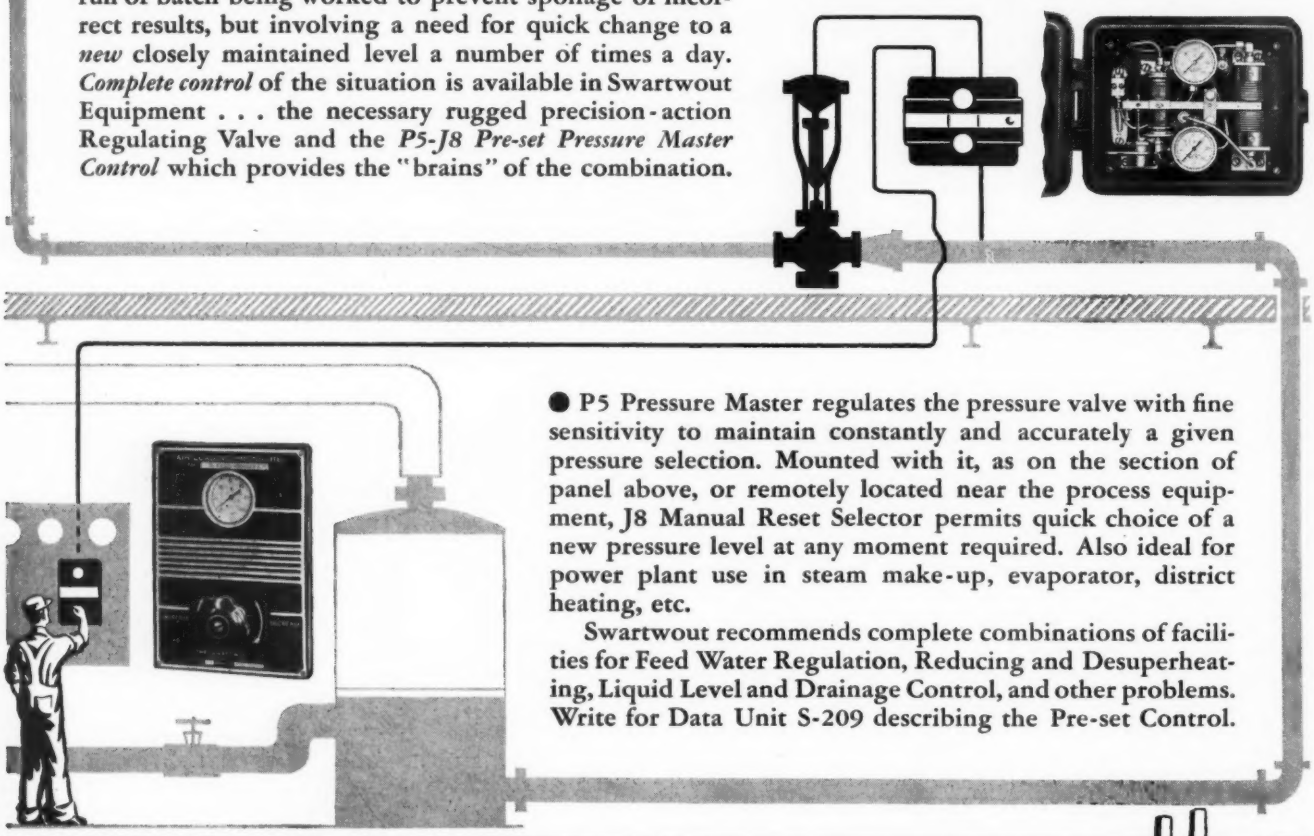
Quick pressure changes FOR SAFE PROCESSING and general applications



With this Swartwout pre-set control combination you can make rapid adjustments in controlled pressure levels

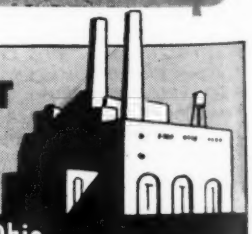
● Suppose you use processes which require closely maintained pressures — accurate, on-the-line, constant, for the run or batch being worked to prevent spoilage or incorrect results, but involving a need for quick change to a *new* closely maintained level a number of times a day. *Complete control* of the situation is available in Swartwout Equipment . . . the necessary rugged precision-action Regulating Valve and the *P5-J8 Pre-set Pressure Master Control* which provides the "brains" of the combination.



● P5 Pressure Master regulates the pressure valve with fine sensitivity to maintain constantly and accurately a given pressure selection. Mounted with it, as on the section of panel above, or remotely located near the process equipment, J8 Manual Reset Selector permits quick choice of a new pressure level at any moment required. Also ideal for power plant use in steam make-up, evaporator, district heating, etc.

Swartwout recommends complete combinations of facilities for Feed Water Regulation, Reducing and Desuperheating, Liquid Level and Drainage Control, and other problems. Write for Data Unit S-209 describing the Pre-set Control.

Swartwout POWER PLANT EQUIPMENT



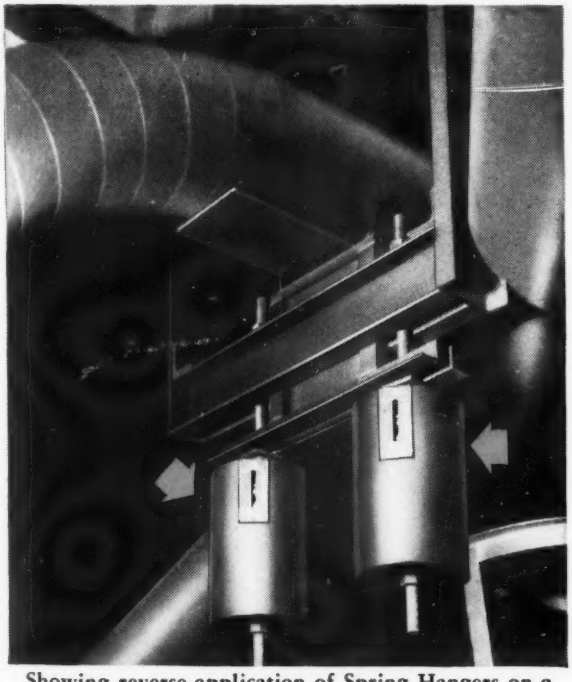
THE SWARTWOUT COMPANY • 18511 Euclid Ave., Cleveland 12, Ohio

Flexible support for pipe that S-T-R-E-T-C-H-E-S

with GRINNELL PRE-ENGINEERED SPRING HANGERS

Selecting hangers for piping subject to thermal movement is completely simplified. Grinnell Pre-Engineered Spring Hangers are available in stock sizes for any load requirement.

Simply compute the load and order the proper size Grinnell Pre-Engineered Spring Hanger as indicated in the Capacity Table appearing in descriptive catalog. 14 sizes with load range from 84 lbs. to 4,700 lbs.



Showing reverse application of Spring Hangers on a flexible piping support.

Flexible suspension of piping in one of world's largest catalytic cracking plants.

LOOK AT THESE FEATURES . . .

- **The maximum variation in supporting force per ½" of deflection is 10½% of rated capacity—in all sizes.**
- **Guides prevent contact of coils with casing wall or hanger rod and assure continuous alignment and concentric loading of spring.**
- **Compact—minimum headroom made possible by precompression*.**
- **Precompression* assures operation of spring within its proper working range where variation in supporting force is at a minimum.**
- **All-steel welded construction meets pressure piping code.**
- **14 sizes available from stock—load range from 84 lbs. to 4700 lbs.**
- **Easy selection of proper sizes from simple capacity table.**
- **Installation is simplified by integral load scale and travel indicators.**
- **Unique swivel coupling provides adjustment and eliminates turnbuckle.**

Precompression is a patented feature

Write for descriptive folder on Pre-Engineered Spring Hangers Fig. 268.

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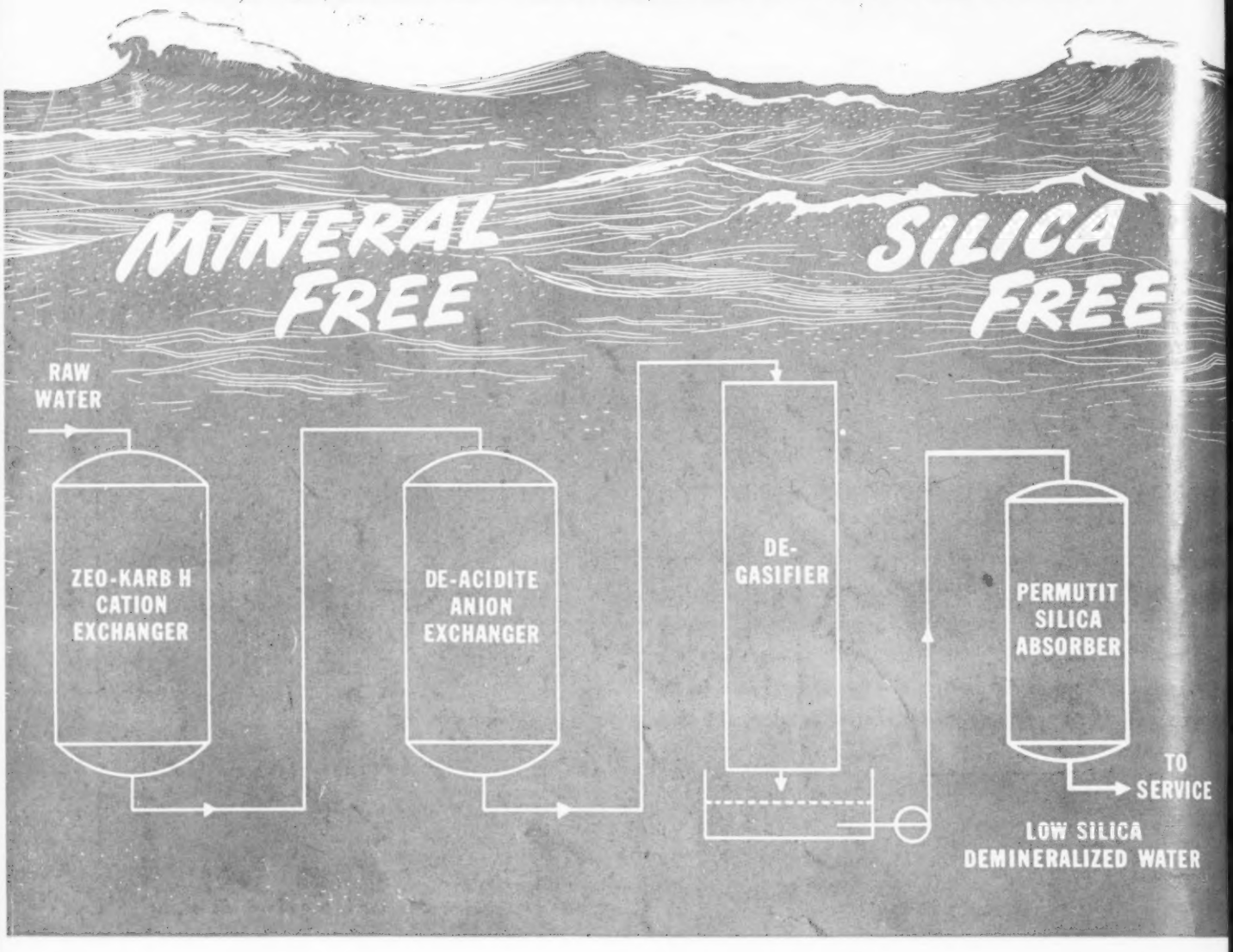
GRINNELL
FOUNDED 1850
WHENEVER PIPING IS INVOLVED

Here's water that's



This new Permutit chemical process produces the equivalent of evaporated make-up water at tremendous savings. Permutit has added to its ionic demineralizing plant this one-step cold process silica removal unit. The result: *low silica* (less than 0.5 ppm) *demineralized water!*

This two-step demineralizing process utilizes Zeo-Karb H, Permutit's acid-regenerated cation exchanger, to replace metallic cations with hydrogen ions. Thus, salts present in the solution are converted into corresponding acids. These acids are then removed from solution by De-Acidite, Permutit's resin anion exchanger.

For full details on this Permutit process, and on other Permutit products for power plants, write to The Permutit Company, Dept. P-7, 330 West 42nd Street, New York 18, New York, or to the Permutit Company of Canada, Ltd., Montreal.

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Deaerators and Open Heaters • Supplementary Chemical Feeding Equipment • Sludge Blanket Hot Lime-Soda Softener • Continuous Blowoff Equipment • Demineralization Combined with Silica Removal • Silica Removal by Hot or Cold Precipitation Processes • Zeo-Karb—Hydrogen and Sodium • Ranarex Mechanical CO_2 Indicators and Recorders

FOR 35 YEARS

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